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Have Magic Screen, Will Travel

The first two hour-long shows in the Bell System's new TV Science Series proved to be extremely ambitious. The first program, "Our Mr. Sun," which was shown last November, described how the workings of the sun made life on this planet possible; the second program, "Hemo the Magnificent," which was shown last week, described how the blood circulates and what it does. Although both programs were excellent once they got down to business, a good deal of dust was raised in the process. Too much was going on besides science.

The opening quarter of "Our Mr. Sun" was devoted to a story about two characters in search of what they called a "gimmick." The gimmick was supposed to solve the problem that the series itself faced—namely, how to blend instruction with entertainment. The solution, which was also employed in "Hemo the Magnificent," turned out to be a kind of dialectic or debate to the finish between the two characters, who addressed each other respectively as Dr. Research (played by Shakespearean Scholar Frank Baxter) and Fiction Writer (played in the first show by actor Eddie Albert and in the second by actor Richard Carlson).

Dr. Research had at his disposal a Science Screen, upon which at his command of "roll four" or "roll six" a hidden projectionist flashed sequences to illustrate the point at hand. Fiction Writer had a Magic Screen, upon which he was able to summon the products of his imagination. These products were animated cartoons of grumpy turtles, dopey squirrels, and other Disney-type animals, as well as Mr. Sun, his side-kick Father Time, and other personifications of natural forces. The result was confusing, but worse, somewhere along the line the signals got crossed, for a certain anthropomorphism came to dominate *both* screens, with, for example, a cartoon figure repesenting hemoglobin on the Magic Screen and a crew of little men operating heart valves in a cartoon account of the circulatory system on the Science Screen.

In contrast, when the shows got away from this story within a story bit to tell us some of the achievements of science, the going was fine. Some of the film clips of actual phenomena, whether viewed in color or black and white, were fantastic: bright streamers of solar material that seemed to precipitate out of empty space to fall into the sun; red blood cells passing in single file through capillaries. If truth is stranger than fiction, this is the stuff that proves it. And some of the animated sequences at least demonstrated the possibilities of this medium as an aid in presenting technical material. Also laudable was the over-all effort to present scientific inquiry as an enterprise that has much in common with more familiar human pursuits.

Exciting as are the achievements of science, we are ready to agree that something in the way of a gimmick is still necessary. It seems to us, however, that the trick lies closer to hand. The subject matter of science differs from one branch to another, but the method of science, in its most general features, is always the same—and there is the gimmick. If scientific theories were presented in terms of that combination of reason and experiment that proves them true, the resulting account would not only be better entertainment, but would also provide a clearer idea of what science is all about. —J. T.

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Russian Translation

Ralph E. O'Dette

Translation from the Russian could be discussed from any one of a number of different points of view, and each phase of the general problem might warrant a separate paper. The following, however, are representative questions asked about the National Science Foundation (NSF) Foreign Science Information Program, and it is these questions which will provide the basis for the present comments: (i) Why is there a national translation program? (ii) Is Russian research really worth the effort? (iii) How is duplication prevented? (iv) Why are other languages not translated? (v) How long will the NSF program last?

NSF grants for support of translation have been made at the request of the professional societies of the United States to improve dissemination of foreign scientific information. Since political considerations play no part in the NSF program, such considerations are not discussed here.

Criteria for NSF Translation Grants

The chief criteria by which a translation proposal is judged at NSF are, first, the value of the information to science and, second, the relative accessibility of the publication in its original form. The consensus has been that many Russian publications report first-class work and are at the same time inaccessible, especially since a measure of accessibility must include scientists' ability to read the original once it is obtained. If the budget for translation were larger, projects in Japanese, Chinese, and other languages would undoubtedly be undertaken. There is a growing feeling that other Eastern European material should be examined more closely, but only one request for support of such work has been received.

Emphasis on translation from the Russian can be explained another way: More of our scientists read German, French, Spanish, and other Western languages than read Russian. If a good, needed German periodical or book and an equally good, needed Russian periodical or book compete for translation funds, the Russian must be chosen simply because it is less accessible to the larger number of scientists.

The NSF Office of Scientific Information does not generate information but is, rather, concerned with all phases of its dissemination. The languages in which information is published are one clear present hindrance to easy flow of research results.

In the United States, we are as provincial as any other nation in ignoring information produced in other countries. Various studies have indicated that emphasizing one's own literature is a national trait (*1*). That this emphasis is not a function solely of the quality or pertinence of the work of one's countrymen is shown by the fact that U.S. writers cite mostly U.S. references, British cite British, French cite French, and so on, not to the exclusion of the work of other countries but certainly to the relegation of "other nation" research to a minor role. It is doubtful that this situation can be explained in terms other than insufficient dissemination of foreign information.

Soviet Dissemination of Foreign Information

Soviet scientists learn English sooner and more thoroughly than we learn Russian (*2*). Consistently, U.S. scientists who have visited Russia have been amazed at the Soviets' knowledge of our literature (*3*). One recent visitor went so far as to state that they probably know our literature better than we do (*4*).

It also appears that the Russians translate on a very large scale (*5*). English and other foreign-language monographs and journals are promptly translated into Russian. Soviet abstracting of foreign literature must be organized and carried on with notable efficiency in order to produce such publications as the huge *Referativnyi Zhurnal* (*Abstract Journal*) and the *Ekspress Informatsiia* (*Express Information*) series, the latter of which is a high-speed method for disseminating information on foreign technologic developments. For example, *Express Information*, issue 19, May 1956, on "Metallurgy and metalworking," a completely random choice as an example, contains illustrated Russian summaries, ranging in length from three short paragraphs to four 7⅞-inch by 11⅝-inch pages, of articles from *Product Engineering* for February, *Aircraft Production* for March, *Metal Industry* for March, *Metal Progress* for January, and *Revue de l'aluminium* for January and February. To accomplish this feat, the Russian All-Union Institute of Scientific and Technical Information received, evaluated, summarized, translated, and reproduced this material within 2 to 3 months of its original publication. *Express Information* also covers general technology, the petroleum industry, radio engineering, agricultural machinery, mining, and some ten other subject areas.

Apart from the authoritarian kind of organization necessary to accomplish such a task the Russians have adopted several other unusual techniques. *Express Information* appears to be photo offset and is on very cheap paper. Most of the illustrations are line drawings, occasionally especially prepared, it would appear, to avoid the halftone, or screened, negative. Abstracts are gathered in loose-leaf fashion in a thin paper wrapper. The *Express Information* series is not attractive, nor is it likely to last very long on a shelf or in a file. But it serves to call to the attention of Russian workers pertinent foreign developments about which they might not otherwise have known.

Mr. O'Dette is program director of the Foreign Science Information Program of the National Science Foundation, Washington, D.C.

Not all Russian publications are produced in this manner or with this speed. Their established research journals had, when last the question was investigated, as long or longer publication delays than ours. Occasionally their papers seem to be overwritten, possibly the result of a less stringent referee system than ours. The quality of their publishing in journals of the quality type does not yet match ours. But the point of issue here is availability of information published in other countries, and here they more than match our efforts.

The description of *Express Information* is not provided for purposes of comparison with a U.S. journal. The Soviet publication is not a journal, and there is no comparable U.S. service. Advocates of rapid abstracting as the best means for disseminating foreign information might do well, however, to study this Soviet effort closely.

It seems clear that much of the Russian information which U.S. scientists are seeking is of the type which the Russians themselves willingly publish and make available to the public. William Locke (*6*) has reported on the discovery of a Russian paper, "The application of Boolean matrix algebra to the analysis and synthesis of relay contact networks," which appeared in an important, readily available Soviet journal; it had simply reposed on a library shelf waiting to be noticed. Locke estimates the cost of tardy discovery of this important contribution to information theory at $250,000.

Translation Projects under Way

Journals. The largest Russian-to-English translation projects for public consumption at present are those of the National Science Foundation, the National Institutes of Health, the U.S. Atomic Energy Commission, and Consultants Bureau, Inc. (*7*), a commercial translating-publishing firm. In terms of sheer bulk, Consultants Bureau, which seems to have pioneered the publication of translated journals in 1949 with a translation of the Soviet *Journal of General Chemistry,* is the largest producer. At the end of December 1956, this firm was publishing 15 translated Soviet journals, some 20,000 pages per year, and planned to issue five more titles in February. These figures do not include the seven journals which they produce as subcontractors to the American Institute of Physics and the American Institute of Biological Sciences.

During December 1956, NSF was supporting, through grants, cover-to-cover translation of four physics journals published by the American Institute of Physics (*8*) and four biology journals published by the American Institute of Biological Sciences (*9*). The Office of Naval Research had contributed a large part of the cost of one of the physics journals. Grants were also supporting three annual volumes, totaling roughly 1000 pages, of selected mathematics papers, published by the American Mathematical Society. Planning for two translated geophysics journals was well advanced, and proposals were being discussed in mechanics, metallurgy, and electronics.

The Atomic Energy Commission is interested in the translation of complete journals applicable to the national atomic energy program and is cooperating with NSF in developing such a program. The National Institutes of Health are supporting two of the Consultants Bureau journals—*Biochemistry* and *Bulletin of Experimental Biology and Medicine*—and have recently awarded contracts for the translation and publication of six additional Soviet journals in medical research (*10*).

Three other commercial publishers were producing translated Soviet journals as this article was written. *Atomic Energy* (*Atomnaia Energiia*) was being offered on subscription by Consultants Bureau and Associated Technical Services (*11*), and Pergamon Press, Ltd., was binding translations of a large part of the Soviet journal with their *Journal of Nuclear Energy*. The Physics Series of the *Bulletin of the Academy of Sciences of the U.S.S.R.* (*Izvestiia Akademii Nauk SSSR: Seriia Fiziki*) was being published by Columbia Technical Translations (*12*). A prospective new entrant into the translated journal field is the Pergamon Institute (*13*), now in process of incorporation in the United Kingdom and the United States, as a nonprofit institution. Although broad plans of the institute are known, specific projects had not yet been initiated at this writing.

Separate articles. An almost-impossible-to-estimate number of translations of separate articles are being made by commercial translating firms. A further sizable quantity of this kind of translation is carried on by many agencies of government in this country and abroad (*14*, p. i; *15*). The Atomic Energy Commission, for example, annually contracts for the translation of articles from Soviet journals not translated heretofore. These translations are announced in *Nuclear Science Abstracts,* available from the Government Printing Office.

Among the agencies of other governments active in translating from Russian to English are the Ministry of Supply and the Department of Scientific and Industrial Research (DSIR) of the United Kingdom, the National Research Council of Canada, the Commonwealth Scientific and Industrial Research Organization of Australia, the Atomic Energy Research Establishment at Harwell, and the Indian National Scientific Documentation Center in New Delhi.

The DSIR publication, *Translated Contents List of Russian Periodicals,* provides a wide variety of useful information. First, it describes the interesting scheme whereby DSIR will share the cost of preparing to order translations requested by at least two citizens of the United Kingdom. Translated tables of contents of a number of current Soviet journals are listed, as are translations available at the Science Museum Library. British Museum accessions of Russian books and serials are also noted.

Translation Monthly, published by the Special Libraries Association, serves a very specific purpose as a catalog of special translations and is described in more detail later. The Library of Congress *Bibliography of Translations from Russian Scientific and Technical Literature* ceased publication with December 1956, but its contents have been absorbed by *Translation Monthly.* However, back copies of the monthly *Bibliography* are useful references.

A Preliminary Guide to Translations, listing a number of sources, will be available momentarily from the Government Printing Office. This U.S. Public Health Service publication, which emphasizes medical translation activity, was compiled by the National Library of Medicine, with assistance from the National Institutes of Health and the National Science Foundation. The *Guide* is an outgrowth of a mimeographed list originally used by the Armed Forces Medical Library to answer inquiries.

Although it does not deal with translations or exclusively with science, the Library of Congress *Monthly List of Russian Accessions* is an excellent guide to current Russian publications, since the translated titles of all accessioned material are included.

Book Translation

Translating books is certainly not a new idea. One of the publishers' criteria usually is that the original text meets an informational need not satisfied by a current book in English. Another criterion is, of course, that the book will sell. The first criterion should always be clearly satisfied; it is with the second that problems begin to arise.

The second criterion is a more difficult one in this day of steadily increasing publication costs (including the tremendous factor of getting the printed book from the presses to a buyer who has been made aware of his need for it) and in-

creasing specialization among researchers. A major publisher has said that he generally cannot accept a book that is likely to sell fewer than 5000 copies in one edition. Smaller, more specialized publishers will contemplate smaller sales. A typical university press may find 2500 copies as the break-even point for a nonsubsidized book if the author is not paid for his manuscript.

Since NSF is concerned by law with the kind of research variously labeled basic, fundamental, or undirected, it seems inevitably to follow that most proposals for translation of books deal with books which have an expected sale of 500 copies during their first 10 years. With the program restricted to Russian books, as it is at present, the problem of sufficient financial support of book translations is still almost insurmountable. The Russians are prolific producers of books (*14*, p. 3; *16*) and the consensus of experts is that the best Russian authors reserve some of their best work for books which often constitute first publication of important research information.

Because of its extremely limited book-translation funds, NFS has been forced to devise a stringent policy for this activity. A book which seems to promise a large sale will simply be called to the attention of a commercial publisher. A book in the "gray area" of probable sales less than 2500 copies might be called to the attention of a university press.

If an apparently worth-while book seems prevented from publication because of the cost of translating the manuscript, NSF will consider lending assistance. If a publisher will assume publication costs, and the book is properly judged by a panel of reviewers to be of significant value to science, NSF can seriously consider supporting the preparation of an edited translation.

This kind of policy does, it is felt, guarantee the expenditure of NSF funds only on eminently worthy books. It is also clear, unhappily, that a great many eminently worthy, but highly specialized, books will probably await support until funds may become more plentiful in another year. It is impossible to avoid adding the personal comment that one of the most difficult aspects of administering the translation program is that of having to participate in the refusal to support translation of a book which is so good that only 300 to 500 scholars can possibly profit from its availability in English.

To date, NSF has awarded grants to translate a very few books. Several interesting proposals are pending. Both the National Institutes of Health and the Atomic Energy Commission also plan to arrange for the translation of significant Russian monographs.

Why Translate Journals?

Translation of complete journals is questioned in some quarters. Is any given journal worth this kind of treatment? The answer seems a rather irrefutable *Yes* when one considers all the factors involved.

Translation of a complete journal is advisable when the consensus of subject specialists is that a reasonable percentage of the articles in the journal will be useful to scientists. No one is surprised if *Comptes rendus* or one of the *Zeitschrifte* prints an occasional mediocre paper, or if *all* the papers do not happen to pertain to a given reader's special interest. The same attitude has been applied to the leading Soviet journals with the additional qualifying consideration that fewer members of the English-speaking community can read the original Russian than can read the French or German (*17*).

The question of cost also points to translation of complete journals in many instances, as the following examples indicate. As a theoretical ideal, it has been suggested, a board of bilingual subject specialists should review the Soviet literature and select the "best" papers. If these are translated and published separately, an individual need obtain only those he really wants. Perfect translations, linguistically and technically, can be obtained by assigning linguists to translate and subject specialists to edit and perfect the translations.

NSF supported such a project at Columbia University. Excellent translations of 230 Soviet physics papers were produced, and they can be purchased for 10¢ each from the Office of Technical Services of the Department of Commerce. There has been little demand for the translations, primarily because their announcement and distribution did not fit into conventional scientific information channels.

A different approach is being tried by the National Institutes of Health. For *Biochemistry* and the *Bulletin of Experimental Biology and Medicine*, NIH has agreed to purchase from Consultants Bureau a certain number of copies of each issue at a reduced price, the total purchase price being calculated to cover most of the translation and production costs for the two journals. This has enabled Consultants Bureau to lower the price to all subscribers to the same figure as that paid by NIH. In support of the NIH research grant activities, the copies purchased by NIH are distributed to a carefully selected list of nonprofit and tax-supported institutions conducting research in the fields covered by the journals, and to appropriate Government agencies. Among the recipients of the free copies from NIH are many institutions which might otherwise not have been able to afford the journals, even though the publications now cost less than one-fourth of their former price.

In order to cover specialized, as well as basic, medical fields, NIH is providing a contract translation service to the editors of professional journals. NIH has sent translated tables of contents of the Russian specialty journals and has invited American editors to select papers for translation and possible republication in accordance with their editorial policies. This program has just been launched.

How an NSF Translation Project Operates

The NSF grant system differs from the NIH scheme in several important aspects. While NIH was instructed by Congress to establish a Russian medical translation service, NSF is expected to serve the physical and natural sciences. The current translation budgets of the two groups are very nearly the same.

The American Institute of Physics translation project may be cited as an illustration of how the NSF support scheme works. First, the institute proposed a survey to obtain the advice of U.S. physicists. NSF supported the institute in such a survey, conducted by Dwight E. Gray, then of the Library of Congress, and Elmer Hutchisson, of Case Institute (*18*).

Respondents to the survey concurred remarkably on the following points: (i) The Russian material is important and should be translated. (ii) Translation is important to science as well as to the national welfare. (iii) Complete journals should be translated because no group is competent to decide upon what is important to everybody. What seems pointless this year may be the key to major achievements next year.

The survey also produced a preference listing of journals, important enough, according to respondents, to justify complete translation. Many respondents viewed the surveyors' cost estimates for a translation project (the estimates later proved surprisingly good) with pleased surprise. "It would be worth it at 2 (5, 10, and so forth) times the cost," was a typical comment.

The leading journal according to the survey was chosen for the first project. This was the ***Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki***, known in translation as ***Soviet Physics—JETP***. After a little more than 1 year, the journal has acquired more than 750 subscribers and is still growing.

To produce the journal, the institute appointed Robert Beyer, of Brown University, as editor. Beyer is a physicist

who reads Russian. Slowly and painstakingly he compiled a list of willing individuals with competence in Russian, English, and one or more branches of physics. Beyer tears apart the issues of the Soviet journal as he receives them in his office at Brown, and he mails separate articles to translators chosen from his list according to subject specialization. One man may thus be asked to translate three articles from one issue, another may receive only one article in 6 months. The translators are paid.

Beyer edits the translations, and photo-offset copy is prepared on Varitypers in his office. A commercial photo-offset printer prints and binds the journal, and the American Institute of Physics provides business management for the project.

Subscription money is received by the institute and is added to the grant from NSF in a separate account set up for the purpose. If it had not been for a roughly 70-percent increase in the size of the Soviet journal in 1956, subscription income would probably now be paying all translating and publishing costs. As it is, with continued increases in the number of subscriptions, the journal is paying at least its production costs, and there is still the hope that it may become completely self-supporting.

In order to gain additional experience in methods, when the institute requested an NSF grant to add three more titles to its list [*Journal of Technical Physics, Doklady* (Physics Section), and *Journal of Acoustics*], they chose a contractor, Consultants Bureau, to do the entire job except for certain details of administration. It is too early to detect significant differences between the two approaches.

Cost of Journal Translation

It probably requires about 5 years for a new scientific journal to reach a plateau in the number of subscribers, so it is difficult to predict accurately what the cost experience in the journal translation program is likely to be. It is already quite clear, however, that, ignoring subscription income, NSF-supported journals cost roughly 60 percent less to produce than did the separate-article translations mentioned earlier. With subscription income a factor, the cost to the taxpayer becomes less, and for some of the journals it is hoped that this cost will drop virtually to zero. It is recognized, however, that there are journals which, published in the author's original language, do not achieve this happy fiscal state.

While the typical research journal pays its authors little or nothing for manuscripts, or in many cases must resort to levying page charges, the publisher of a translated journal must add to the normal costs of publishing the high cost of translation. The economics of the situation may be clarified by an example which, while hypothetical, is based on experience.

A typical Russian journal will average 500 words per solid text page. For a physical science or engineering journal, allowance for equations, graphs, data tables, and other illustrations will bring the actual average closer to 300 words per page. One thousand pages per year, therefore, equals roughly 300,000 words. If one organization were to contract to have 1 year of this journal translated for its own use, it would pay in the range of \$6000 to \$9000, and possibly more, especially if the translator has to provide more than 10 or 15 copies or if illustrations are a special problem. With NSF sponsorship, that organization would pay \$25 per year (2½¢ per page, on the average) to subscribe, or \$375 if it needed 15 copies of each issue.

When 150 to 200 organizations subscribe to this hypothetical, NSF-supported journal at \$25 each, they are essentially covering the translation cost. Each gets \$6000 to \$9000 worth of translation for \$25. When the number of subscribers reaches 600, virtually all production costs are being met. As the subscription list swells further, administrative costs are met. In the range of 750 to 1000 subscribers, extra money should begin to come in to support less successful projects or to initiate new ones. The NSF journal-translation budget is thus a revolving fund.

There are numerous other advantages to the complete journal approach to translation besides the economic one. Completely translated journals are covered in the usual way by abstractors and reviewers: they are easy to reference; they are easier to store; in short they have all the advantages of any other journal.

Translation Centers

Although there are many advantages to the translation of complete journals, special translations will always be necessary. To provide an organized approach to this wealth of information, the Special Libraries Association Translation Center has been established at John Crerar Library in Chicago to collect and make available scientific and technologic translations from all languages. This center was established on 1 January 1957 by integrating the SLA Translation Pool and the Library of Congress Scientific Translation Center. It is cooperatively supported by grants from the National Science Foundation and the National Institutes of Health.

Two of the principal services of the Translation Center are provision of inexpensive copies of translations and assistance in preventing duplication of translation effort. The latter aim cannot be achieved with perfection, of course, until all translators provide the Center with copies of their product or with information on what they have done or are about to do. But the present operation is a significant step in the right direction.

It is difficult to state precisely just how much money is saved for whom by the existence of the Center, but a series of crude approximation calculations will serve to emphasize some of the economic aspects.

The average length of the 34 translations of Russian physics papers listed in the November, 1956, issue of the Library of Congress *Bibliography* (No. 38), was 14 pages (*13*). Purchased from the SLA Center where these translations are now on file, an enlargement photostat of this "average" physics translation would cost \$3.80, a microfilm \$1.70. At typical commercial rates this translation would cost in the order of \$60. By extrapolation from these very rough average figures, one finds that the total holdings of the SLA Translation Center (roughly 12,000 translations) could be purchased in photostat for a maximum of \$45,600 or in microfilm for a maximum of \$20,400. If one were to order the total holdings translated commercially for one's own use, the cost would be in the range of \$500,000–\$900,000. While the example may be sophomoric, it does indicate the financial virtues of the kind of cooperative effort exemplified by the Center.

The Translation Center does not translate; it collects translations. Most of the translations on file at the center are gifts or loans from government agencies, both U.S. and foreign, industrial firms, universities, and individuals. In some instances, government-made translations are shipped to the center by the donating agency without agency identification. Industrial firms in such highly competitive fields as pharmaceuticals also donate large numbers of excellent translations in exchange simply for the right to remain unidentified.

Several problems remain to be solved to help the SLA Center achieve its goal of becoming a national depository and reference center on scientific and technical translation. There are probably a number of noncommercial producers of translations who do not contribute their material to the center. It is hoped that the continued growth and increased usefulness of the center will help educate these groups to the importance of their

cooperation. One encouraging factor should be the success of both the Library of Congress and the Special Libraries Association in maintaining the anonymity of contributors who wish not to be identified with their translation work. It is a firm policy of the center to withhold the names of its contributors unless the contributors specifically wish to receive published credit.

Translation centers such as the one in Chicago are potentially among the more important services which can be rendered to users of scientific information. These services will improve only as more and more individuals and organizations contribute their efforts, both toward building the holdings of translations and toward using the existing holdings.

Reviews and Abstracts

Translation of complete journals and books is important because it places at hand a complete version of specific research of probable value. Such translations become an integral part of English-language scientific literature. Special translations are complementary, but the combined production of these activities does not solve the whole problem.

Many years have passed since a scientist could remain familiar with the literature by reading a few journals and the current books. Coincident with the growth of this unhappy state of affairs, reviews and journals of abstracts have assumed more and more importance in the general scheme of scientific communications.

The NSF has made one modest grant to Annual Reviews, Inc., to cover the costs of publishing reviews of Russian progress in those areas where the *Reviews'* editorial boards find such progress to be significant. To date, this grant has resulted in Russian progress reports in psychology, physiology, medicine, plant physiology, biochemistry, and microbiology. One is not to infer, however, that Russian progress in other fields has been judged insignificant. One of the problems in supporting reviews is that there does not seem to be a really clear consensus among scientists on what should be reviewed and how.

Improved coverage of Russian literature (and that of other countries as well) through abstracting seems essential, but it is a many-sided problem. In fields where abstracting is well established—chemistry, for example—careful attempts to achieve thorough coverage are being made. A chemist assumes that if a worth-while paper of chemical interest appears, almost anywhere, it will in time be abstracted by *Chemical Abstracts*. Scientists in other fields have different kinds and degrees of literature consciousness.

A pilot project in increased abstracting is now under way supported by a small NSF grant to *Biological Abstracts*. *Biological Abstracts'* editors have identified 31 primary Soviet biology journals as important, and they have contracted with Consultants Bureau to cull from the *Referativnyi Zhurnal, Biologiia* (*Abstract Journal, Biology*) abstracts of articles from the 31 journals. These abstracts are translated verbatim and published in *Biological Abstracts* in the appropriate subject divisions. No attempt is made to separate these as Russian information: they are treated as information first and Russian incidentally.

Thirty-one journals cover much that is important in Russian biology, but this does not constitute exhaustive coverage. *Biological Abstracts* did not assume, in choosing the 31 titles, that they were achieving comprehensive coverage. Whether or not the program is enlarged will depend on the quality of the Russian material and the comments of *Biological Abstracts'* users.

The National Institutes of Health program includes the translation of approximately 4000 medical abstracts annually. These will be published in a quarterly *Abstracts of Soviet Medicine* by *Excerpta Medica*. This journal will be in two parts, the first devoted to basic and the second to clinical medical sciences. The abstracts will be furnished in part by Russian editors appointed to *Excerpta Medica*'s editorial boards by the Academy of Medical Sciences, U.S.S.R., and in part by systematic selection of abstracts from the four-section Soviet medical abstract publication *Meditsinskii Referativnyi Zhurnal*.

Associated Technical Services is also publishing translated summaries of papers from several important Russian chemical journals.

The abstracting board of the International Council of Scientific Unions has for some time been actively promoting greater international cooperation in scientific abstracting, and NSF has supported its work in part with a grant.

Collection of Source Material

Abstracting and reviewing are one side of a coin, the other side of which is availability of the source publications. It seems certain that abstract journals cannot always guarantee the availability in this country of the material they abstract. Some foreign publications are abstracted by scientists overseas, who are permitted to keep the original publication in payment or part payment for providing the abstract. Obtaining, storing, and servicing all of the publications abstracted by any major service would be a tremendous task for the service and usually is not undertaken. *Engineering Index* is an exception, since the Engineering Societies Library holds all material listed in the *Index*.

An abstract is probably better than no information at all, especially when the abstract is well prepared and informative, but there are gaps in the nation's holding of scientific serials. In order to fill this gap the Midwest Inter-Library Center (MILC) in Chicago has begun establishing a center which aims to make available at one point all of the world's journals that publish results of original research. The first step in what is likely to be a lengthy but relatively inexpensive project was taken by the members of MILC with a search of their holdings for titles of publications abstracted by *Chemical Abstracts*. NSF recently made a grant to the group to enable them to seek out and obtain subscriptions to the titles not regularly received by any member. Of the 4733 titles listed by *Chemical Abstracts* in the December 1951 *List of Periodicals Abstracted*, MILC members were already receiving 3942. The new edition of this list, soon to appear, includes a large number of new titles, and MILC has begun checking members' holdings of the newly added titles. Using coverage of *Chemical Abstracts* as the criterion, MILC–NSF aim in time to have available to any researcher a full copy of any significant chemical paper. This facility is expected to supplement, rather than duplicate, the service already rendered by the American Chemical Society Photocopy Service, since the MILC will initially concentrate on certain rare material which experience has indicated is difficult or impossible to obtain in this country.

Following the start in chemistry, holdings of the journal center will gradually be expanded, probably first to biology, and then to other fields as funds and facilities permit. In this age of tremendous expenditures for research, simple availability of source material seems an obvious necessity not to be ignored simply because it is not costly.

Duplication of Translation

Duplication of effort may be justified in situations of great urgency or when careful verification seems vital. The kind of duplication which NSF and others are trying to help prevent is the inadvertent kind which stems from simple lack of knowledge of what others are doing.

Present intragovernment liaison, while it is informal, seems effective. Scientific information representatives of the many

embassies in Washington and of a number of U.S. agencies meet at an occasional, informal luncheon. A larger "persons interested in scientific information" luncheon is also held monthly to serve a similar purpose on a somewhat larger scale.

Through fairly steady communication between NSF and various agencies of the United Kingdom, NSF has been informed in detail of the current Department of Scientific and Industrial Research program to translate and analyze a sample copy of each section of the huge Russian abstract journal, *Referativnyi Zhurnal.* The Ministry of Supply has provided copies of a significant but limited-by-funds translation project which it is conducting. The *Preliminary Guide to Translations,* mentioned previously, is an interagency voluntary effort and, in itself, is an invitation for the increased cooperation of other agencies as well as commercial translators and publishers.

Problems in Documentation

Soviet literature, in the original Russian or in translation, presents problems in documentation which are beyond the scope of the present discussion. However, several aspects of identification and cataloging are especially pertinent to translation.

One problem will be solved by having new translated journals carry the same volume-number identifications as their Russian counterparts. Existing translated journals which may have started with their own numbering systems will shortly begin to identify themselves more carefully with the Russian original. Contributors to the Translation Center are being asked to provide complete citations with their translations. The expanded *Translation Monthly* features an improved subject index and, probably in the near future, will add a monthly author index. These details seriously affect the accessibility of the translated material. Translations are evolving from the status of occasional pieces to that of full-grown information tools which present new problems to solve, hopefully, as they arise.

As the volume of translated Russian material grows, one stumbles with increasing frequency over the need for better agreement in such matters as transliteration and the rendering into English of key words in Soviet journal titles. Different transliteration schemes are used or advocated by the Library of Congress, the International Organization for Standardization (*19*), and the Royal Society. One occasionally sees other, perhaps intuitive, systems.

Although the systems are similar, they can produce a given Russian author's name as, variously, Jakob, Iakob, Yacob, or some other permutation derived by equating *J*, *I*, and *Y*; *c* and *k*; or *a* and *o*. This causes problems in identification as well as cataloging, especially in dealing with large quantities of material, such as at the Translation Center. The same author may show up in a half-dozen places in the catalog because he has initials as well as a last name. The not-so-hypothetical six places increase with frightening rapidity when one notes that the key words from Soviet serial titles, such as *Doklady, Trudy, Vestnik, Izvestiia, Sbornik, Uspekhi, Voprosy,* and others, can be and are translated in different ways.

The problem is more a matter of semantics than of translation, however. While *Doklady* may literally mean *Reports,* some translators feel that *Proceedings* more accurately conveys the nature of the journal to an English reader. Thus far, the trend for completely translated journals has been to use an identifying English title, acceptable in terms of current usage, plus the original Cyrillic title. Possibly the best solution would be to add a transliterated title and then simply to absorb the Russian words into English usage, just as *Zeitschrift* has been absorbed. An excellent example of where this situation becomes a problem is in the retranslation into English of Russian translations of English references.

Machine Translation

Machine translation can receive here only the briefest attention; therefore, several references are suggested for those interested in more details (*8, 20*). This relatively new field is being followed very closely at NSF, and several grants have been made for research on various approaches to the problem. It is hoped, of course, that machine translation will become the means of the ultimate fast, accurate, low-cost translation which could have such an important effect on dissemination of foreign-language research reports. Until such time, "conventional" translating techniques must be employed.

Learning Russian

The emphasis in this discussion has been on mass translation of important, inaccessible scientific information. Published translation is, of course, duplicating publication. The problem of publishing all research results once is still a gigantic problem, and it is not simplified by duplicate publication.

There seem to be three alternatives. NSF expects to continue its translation program as long as scientists want it and as long as the international situation permits access to the source material. The second alternative is an unlikely return to the custom of publication in a commonly accepted international scientific language, such as the Arabic, Greek, or Latin of earlier centuries. Proceedings of international meetings have been reported in Interlingua (*21*). Since human beings are as they are, however, a universal scientific language seems, to say the very least, a long way off.

The third alternative is more difficult than large-scale translation, simpler than promulgation of a universal language, possible to achieve, and has the added virtue of appealing to one's sense of the fitness of things. More emphasis can be placed on teaching scientific Russian to science students.

Research-oriented graduates have traditionally learned French and German, not solely as a doctorate requirement but because in many instances they knew they would have to depend on these languages to keep abreast of their professions, for example, organic chemistry and the German literature.

We may be long in accepting it because it has come upon us with surprising speed, but the fact of the matter is that Russian is now definitely a language which research-oriented graduates should know. This is said not to depreciate the importance of French, German, or other languages but to emphasize the new, radical aspects of the situation.

An interesting symptom of increasing interest in this problem is the proposal announced by the Pergamon Institute at the recent AAAS New York meetings. Described as in the planning stage was a symposium on the teaching of scientific Russian to be held in London in July 1957. Representatives of Columbia, Harvard, Cambridge, London, and Oxford universities were said to have agreed to participate.

Summation

This discussion has described the status of the large United States program for translation from the Russian. A partial description of what is being done or planned, and by whom, has been provided as a guide for those who wish to follow the subject further. The urge to pass on useful information has necessarily restricted the space which might also have been profitably devoted to the philosophic aspects of the problem.

Although it is not said with any sense of pride in achievement—because much more remains to be done than has been done—it would seem fair to describe the current national translation activity, in-

cluding all contributions to it, as a phenomenon. Phenomena in scientific communication are not common: a full appreciation of their significance requires more analysis than results from a simple listing of their outward characteristics. But a few observations might be made in conclusion.

Most United States scientists probably feel that, as a nation, we are and should be world leaders in science, even though this feeling is neither nurtured nor expressed in a spirit of violent competition. If this assumption is allowed, the point which seems to remain is that the United States will not retain its position casually. Our scientists expect to maintain an awareness of the scientific achievements and failures of the other nations of the world. But we must especially become more aware of the advances of Soviet science, both qualitatively and quantitatively. The evidence points toward this last conclusion, regardless of whether one is concerned with the production of ideas or things, increase in man's knowledge of himself and his environment, conflict between idealisms, or simply the national security.

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Penalty of Isolationism

Selman A. Waksman

The identicalness of two antibiotic preparations, one isolated in 1946 and designated as "grisein" (*1*) and the other isolated 5 years later and designated as "albomycin" (*2*), leads once more to a sad reflection of the penalty that must be paid for scientific isolationism, which may even be colored by scientific nationalism.

If ever isolationism has been dangerous in any field of science, if ever rapid development in such a field has required close international collaboration among different scientific groups, it has been particularly true of the study of antibiotics. The study of the formation, isolation, chemical identity, and biological activities of these microbial products requires rather specialized procedures in biology and biochemistry. Our knowledge of antibiotics and their extensive applications is of only very recent origin. It involves a knowledge of the antibiotic-producing organisms, which may vary greatly in nature, of the chemical substances produced by these organisms, of the antimicrobial activities of these substances, their pharmacological properties, and their practical potentialities as therapeutic agents.

One of the most striking illustrations of the need for close collaboration in this field was recently presented by the isolation in four different laboratories in the United States and in Western Europe of preparations which, on careful comparison, proved to represent the same chemical and biological entity. This could be established, not only by a comparison of the physical and chemical properties of the preparations, but even more simply by the use of organisms of known sensitivity to different antibiotics. Developments in the case of grisein and albomycin would seem to provide an equally striking illustration.

Isolation of Grisein

Following the isolation in our laboratory, from cultures of actinomycetes, of actinomycin in 1940, streptothricin in 1942, and streptomycin in 1943, the search for organisms capable of producing antibiotics that were active upon bacteria resistant to streptomycin was continued. This search resulted in the isolation in 1946, from the Huleh peat of Israel, of a strain of *Streptomyces griseus* that produced an antibiotic different from streptomycin. It was designated *grisein*. This antibiotic inhibited in very high dilutions the growth of certain Gram-positive bacteria, such as *Micrococcus pyogenes* var. *aureus* (*Staphylococcus aureus*) and *Bacillus subtilis*, and of Gram-negative bacteria, such as *Escherichia coli* and *Serratia marcescens*. The activity of the antibiotic produced by this culture was much greater against staphylococci than against *Escherichia coli*. Unlike streptomycin, it had no activity against *Bacillus mycoides*, *Proteus vulgaris*, and *Salmonella typhosa*, and only limited activity against mycobacteria. Sensitive bacteria rapidly developed resistance to grisein, so much so

The author is director of the Institute of Microbiology, Rutgers University, New Brunswick, N.J.

that the broth-dilution method could not be used for measuring its concentration.

Grisein was adsorbed on charcoal, removed with neutral alcohol, and precipitated with methanol. It was insoluble in ether, chloroform, absolute acetone, absolute ethanol, and benzene. It was water-soluble and heat-stable. It possessed but little toxicity to experimental animals. It was active *in vivo,* protecting experimental animals against infections with *Micrococcus pyogenes* var. *aureus* and *Salmonella schottmülleri.*

The addition of iron salts to the medium had a highly favorable effect on the yield and activity of grisein. This was true particularly for synthetic media, in which a direct parallelism was obtained between the concentration of iron and the production of grisein (*3*). However, addition of an excess of iron to the antibiotic preparation reduced its activity. There were marked differences in the chemical composition and biological behavior of grisein and streptomycin, as was evidenced by the sensitivity of streptomycin to sulfhydryl and carbonyl groups and by the absence of such sensitivity in grisein, and there were also differences in the antibiotic spectra; there was no cross resistance between the two antibiotics. Strains of *Streptomyces griseus* producing griseinlike antibiotics were soon isolated in our laboratory from the intestinal contents of a heifer (*4*) and from a Japanese soil (*5*).

Upon further study, it was decided that the narrow antibiotic spectrum of grisein and the readiness with which bacteria developed resistance to it hardly justified the use of this product in clinical medicine.

Kuehl and his collaborators (*6*) proceeded with the isolation of chemically pure grisein. They succeeded in obtaining preparations of a very high potency and giving an activity of 300 million *Escherichia coli* units per gram. The pure grisein was a red amorphous powder soluble in water and phenol. The chemical formula of $C_{40}H_{61}N_{10}O_{20}SFe$ was assigned to it. Hydrolysis of the grisein preparations gave a large number of amino acids, one of which was identified as glutamic. The iron in the molecule was found to be in a ferric state. It could be removed from the complex, giving colorless and partly inactivated preparations. When a small quantity of iron was again added to the preparation, the color and the high level of antibiotic potency were restored. An excess of iron inactivated grisein.

Isolation of Albomycin

In 1951, Gause and Brazhnikova (*7*) reported the isolation from a culture of *Streptomyces,* referred to as *Actinomyces subtropicus* (*8*), of a new antibiotic, which was named *albomycin.* This antibiotic was found, when tested by the agar-diffusion method, to inhibit the growth of various Gram-positive cocci and certain Gram-negative bacteria, including those resistant to other antibiotics. Pure preparations of albomycin were active against staphylococci in a dilution of 1 to 700 million (*9*). Like grisein, it had no activity against *Bacillus mycoides* and *Mycobacterium tuberculosis.* It was practically nontoxic to animals. Pure albomycin was an amorphous red powder, soluble in water, and insoluble in organic solvents. Its characteristic property was a high content of iron (4.16 percent). When the iron was removed from the albomycin molecule, the orange color of the preparation disappeared and its antibacterial activity was greatly reduced. When the iron was again added to the antibiotic preparation, the color and activity were restored. Albomycin represented a cyclic polypeptide, which gave, on hydrolysis, various amino acids, one of which was glutamic. The adsorption spectrum reported for albomycin corresponded exactly to that of purified grisein—namely, maximum distinguishing peaks at 265 and 420 millimicrons. A molecular weight of about 1300 was assigned to albomycin. It was active only in the presence of oxygen. Increasing additions of iron decreased the activity of the antibiotic (*10*).

Grisein Reexamined

A comparison of the antimicrobial, physical, and chemical properties of albomycin with those of grisein leads one to the inevitable conclusion that the two are closely related if not identical. No comparison could be made of the cultures that produced the two preparations, for the Soviet culture was not available for study. It is rather surprising that in none of the Soviet papers cited in connection with the work on albomycin was there any comparison between albomycin and grisein, although in one paper there is a brief comment that grisein is the only other antibiotic containing iron, but that the antibiotics differ. The only apparent evidence submitted to support this statement is found in a reference (*7*) to the fact that grisein is not active against *Aerobacter aerogenes,* while albomycin is active against this organism. Obviously, the strains of the test organism could have been different, since no attempt known to me was actually made to compare the two antibiotic preparations.

In a comparative study of some recently isolated antibiotics, Garrod and Waterworth concluded (*11*) that albomycin was the least promising. They emphasized also that the broth could not be used for testing purposes, since this antibiotic failed to inhibit the growth of *Micrococcus pyogenes* var. *aureus,* although it did so in agar media. Among the Gram-negative bacteria, *Escherichia coli* was sensitive to albomycin, whereas *Proteus mirabilis, Salmonella typhosa,* and *Pseudomonas aeruginosa* were highly resistant. They also noted, among sensitive organisms, the rapid development of resistance to albomycin. All these properties are characteristic of grisein.

Elsewhere in this journal, Stapley and Ormond (*12*) present experimental evidence "that albomycin and grisein are chemically very similar and identical with respect to antimicrobial activity." Just as was reported (*1*) for grisein, albomycin is highly active against *Micrococcus pyogenes* var. *aureus* and *Salmonella schottmülleri,* and it shows little activity against *Salmonella typhosa* and *Proteus vulgaris.* Biological identity of the two preparations is further substantiated by their activity against sensitive strains of *Escherichia coli* and their lack of activity upon resistant strains of this organism.

Summary

Research on new antibiotics is engaged in at present throughout the world with such intensity that one must be able to compare cultures of organisms producing such antibiotics, as well as the isolated substances themselves, if one is to avoid needless duplication and great confusion. As long as no international center exists where such comparisons can be made, only close collaboration among scientific laboratories can make possible these essential comparisons. The repetitions and the frequently unjustified creation of "new species" of antibiotic-producing organisms and of "new antibiotics" can be avoided only by close collaboration among the scientific workers throughout the world. The creation of an International Antibiotics Board is also highly essential at the present time.

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Similarity of Albomycin and Grisein

Edward O. Stapley and Robert E. Ormond

In the course of an investigation into the nature of albomycin, an antibiotic described by Gause (*1*) as a product of *Actinomyces subtropicus,* considerable data have been obtained indicating similarity of this product to grisein, which has been described by Reynolds, Schatz, and Waksman (*2*) as a product of *Streptomyces griseus.* We have also obtained information on the existence of several components in partially purified grisein which have not been described previously.

Information on the chemical constitution of grisein and albomycin published by Kuehl, Bishop, Chaiet, and Folkers (*3*) and Gause (*1*), respectively, suggests possible similarity, since both antibiotics are described as red-colored, amino-acid containing, iron complexes. Both substances are very active on a weight basis against sensitive bacteria.

Materials and Methods

We have had available ampules of albomycin obtained from international sources and also a preparation of albomycin obtained directly from G. F. Gause through S. A. Waksman. The potency of the albomycin employed in our studies was 91,000 units per milligram. Comparison was made with two partially purified concentrates of grisein prepared at Merck and Company, Inc., that were active at 41,000 and 22,000 units per milligram, and with a crude preparation of grisein prepared in the laboratory of S. A. Waksman in 1948, which proved to be active at 312 units per milligram in a recent assay. All assays were performed by the agar diffusion method with *Escherichia coli* as the test culture and a standard based on an assigned value of 300,000 units per milligram for the pure grisein of Kuehl *et al.* (*3*).

The authors are on the staff of the Merck Sharp and Dohme Laboratories division of Merck and Company, Rahway, N.J.

Paper-strip chromatograms were developed on Whatman No. 1 filter paper. Bioautographs were obtained by placing air-dried paper strips on the surface of large baking dishes of nutrient agar seeded with *Escherichia coli* W followed by incubation at 25°C for 18 hours. Ascending paper chromatograms were developed at room temperature until the solvent front had moved 25 to 30 centimeters. Descending paper chromatograms were run so that the fastest moving component had traveled approximately 24 centimeters in 52 hours when they were developed at 28°C with a solvent mixture of butyl alcohol (4 parts), acetic acid (1 part), and water (5 parts). The strips were developed with the solvent phase after a 3-hour equilibration with an atmosphere saturated with the water phase.

Column partition chromatography was accomplished by pouring a solution of 1.1 grams of grisein (22,000 units per milligram) in 40 milliliters of upper phase from an *n*-butyl alcohol (4 parts), acetic acid (1 part), and water system (5 parts) over 800 grams of pulverized paper wet with lower phase. The column was developed with upper phase. Starting just before the first yellow eluate came off the column, 25-milliliter aliquots were collected, absorption at 4250 A was determined, and the reading was plotted. The peak fractions were combined, concentrated in a vacuum, and lyophilized. Repartition of 134 milligrams of a combined fraction (Fig. 1, tubes 71 to 150) with 60,000 units per milligram containing mainly component C was carried out in the same fashion as the original column partition, using 300 grams of pulverized paper. Eluate aliquots of 9 milliliters each were taken by a fraction collector, and the ultraviolet absorption at 4250 A was measured.

Data from the column partition were compared with a 39-plate countercurrent distribution of grisein (41,000 units per milligram) employing 2*M* phosphate buffer at *p*H 6.7 and 10 grams of solid phenol diluted to 100 milliliters with chloroform. The countercurrent fraction where $K = 0.26$ corresponded to the fraction from which pure grisein was originally obtained by Kuehl *et al.* (*3*).

Results and Discussion

In our tests of grisein and albomycin, we noted that the inhibition zones produced on disk or cup-plate assays were very similar, especially with regard to the rapid appearance of resistant colonies within the inhibition zone. The capacity of grisein to permit exceptionally rapid development of resistance and the characteristic hazy appearance of inhibition zones produced as a result of rapid development of resistance have not been

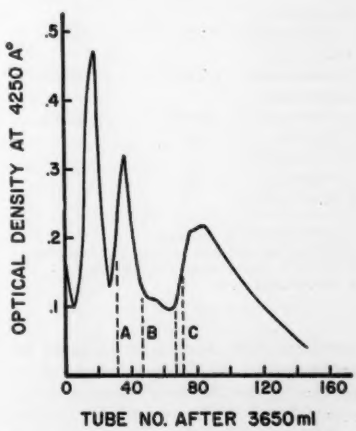

Fig. 1. Column: partition chromatography of grisein. The curve shows the ultraviolet absorption at 4250 A of 25-milliliter aliquots eluted from a cellulose column that was charged with grisein (22,000 units per milligram).

Table 1. Comparison of the cross resistance of albomycin and grisein. The test of cross resistance of albomycin and grisein was made using filter paper disks 13 millimeters in diameter on nutrient agar plates seeded with *Escherichia coli* W and 12 antibiotic-resistant strains obtained from *E. coli* W.

E. coli W	Zone of inhibition (mm)	
	Albomycin (10 μg/ml)	Grisein (10 μg/ml)*
Sensitive parent	24	22
Streptomycin resistant	22	21
Streptothricin resistant	27	23
Cycloserine resistant	26	23
Pleocidin resistant	35	30
Chloramphenicol resistant	35	28
Chlortetracycline resistant	35	31
Oxytetracycline resistant	35	26
Neomycin resistant	35	26
Tetracycline resistant	35	31
Viomycin resistant	0	0
Grisein resistant	0	0
Albomycin resistant	0	0

* 41,000-unit/mg preparation.

Table 2. Antibacterial activities of albomycin and grisein by the cup-diffusion method.

Test culture	Zone diameters (mm)	
	Albomycin (5 μg/ml)	Grisein* (5 μg/ml)
Micrococcus pyogenes var. *aureus*	25.5†	15.0†
Diplococcus pneumoniae	23.5	21.0
Klebsiella pneumoniae	24.0	18.0†
Salmonella schottmülleri	24.0†	22.0†
S. typhosa	§	§
Pseudomonas aeruginosa	±‡	§
Proteus vulgaris	§	§

* 41,000-unit/mg preparation.
† Resistant colonies present in zone of inhibition.
‡ Inhibition zone beneath the cup only.
§ No inhibition zone.

Table 3. Paper-strip chromatograms of albomycin and grisein. The antibiotics were compared by ascending paper chromatography on Whatman No. 1 filter-paper strips, bioautographed against *Escherichia coli* W. The figures in parentheses in column 1 indicate the proportions of the components in the solvent systems.

No.	Solvent system	R_f values	
		Albomycin (0.4 μg)	Grisein (0.5 μg)
1	*n*-Butanol (4), H_2O (2), acetic acid (1)	0.14, 0.33, 0.46	0.14, 0.37, 0.46
2	*n*-Butanol (1), H_2O (2), acetic acid (1)	0.83	0.83
3	Methanol (3), 0.1*N* HCl (1)	0.68	0.68
4	*n*-Propanol (10), 2.5% NaCl (8), acetic acid (1)	0.79	0.78
5	*n*-Butanol (25), ethanol (25), H_2O (47), acetic acid (3)	0.75, 0.92	0.97
6	Acetone (60), H_2O (37), acetic acid (3)	0.71	0.75

noted for other antibiotics produced by actinomycetes. Rapid development of resistance to the antibiotic action of albomycin has been noted also by Garrod and Waterworth (*4*).

Cross-resistance tests have revealed a close relationship between albomycin and grisein in their biological activity. The results of testing both antibiotics against 12 antibiotic-resistant strains of *Escherichia coli* W are presented in Table 1. These data demonstrate that albomycin and grisein are mutually cross-resistant and that both are cross-resistant with viomycin, while neither is cross-resistant with any of nine other antibiotics produced by actinomycetes.

A comparison of the activities of albomycin and grisein against various pathogenic bacteria, as reported in Table 2, is consistent with the other observations on the similarity of albomycin and grisein. A low degree of activity, if any, against *Salmonella typhosa, Pseudomonas aeruginosa,* and *Proteus vulgaris* has been reported for grisein by Reynolds *et al.* (*2*) and in our laboratories has been found to be characteristic of purified grisein and of fermentation broths that contain grisein.

A comparison of albomycin and grisein by ascending paper chromatography with several solvent systems is presented in Table 3. It may be noted that there is a remarkable similarity in R_f values obtained for the two substances, especially in systems 2, 3, and 4. The results obtained with solvent system 1 suggest that both antibiotics are made up of several components. This point has been confirmed by comparison of the antibiotics on descending paper chromatograms with a higher resolving power, as is reported in Table 4. Since the solvent front moves off the strip during the prolonged development time, results are reported as mobilities with respect to the distance traversed by the fastest moving component. The center of spot A on these strips was approximately 24 centimeters from the origin in the case of both albomycin and grisein.

Albomycin appears to be made up of four antibiotic components, three of which are present at detectable levels in the crude grisein (312 units per milligram) produced in 1948 and all of which are found in the partially purified grisein (41,000 and 22,000 units per milligram). Table 5 presents an estimation of the relative antibiotic activities of the four components in crude and partially purified preparations. We have found that component C, the major antibiotic moiety of albomycin, is present in partially purified grisein and is the major component of crude grisein.

Pure grisein as previously described (*3*) is characterized by a paper-strip mobility corresponding to that of component A. Purification studies on grisein product 5 of Table 5 (22,000 units per milligram), a partially purified grisein in which the quantitative distribution of components closely resembles that of albomycin, have demonstrated that component C is converted to component A during the purification process. The mechanism whereby this takes place is unknown; treatment of component C with oxygen, ferric chloride, or the acid alcohol system failed to convert it completely to A.

The results of column chromatography of grisein product 5 (22,000 units per milligram) are presented in Fig. 1. The eluate fractions showing ultraviolet absorption, labeled A, B, and C, correspond to the antibiotic components A. B, and C of grisein. The first optical density peak represents antibiotically inert mate-

Table 4. Comparison of the relative mobility of the components of albomycin and grisein by descending paper-strip chromatography.

Antibiotic	Relative mobility of components			
	A	B	C	D
Albomycin	1.0	0.73	0.59*	0.27
Grisein (41,000 unit/mg)	1.0*	0.75	0.60	0.28
Grisein (22,000 unit/mg)	1.0	0.81	0.58*	0.30
Grisein (312 unit/mg)	1.0		0.65*	0.35

* Indicates location of most active antibiotic zone.

Table 5. Comparison of the relative importance of the four antibiotic components in several grisein preparations and albomycin obtained from paper chromatograms.

No.	Antibiotic*	Potency (unit/mg)	Grisein components			
			A	B	C	D
1	Albomycin	91,000	+++	++	++++	+
2	Grisein	41,000	++++	+++	+	+
3	Grisein	312	+	−	++++	+
4	Grisein	94	++	−	++++	+
5	Grisein	22,000	+++	++	++++	+

* Sample 2 was prepared by Kuehl from *Streptomyces griseus* 25G (culture obtained from S. A. Waksman). Sample 3 was obtained from Waksman. Sample 4 was obtained from Compañía Española de la Penicilina y Antibióticos, S.A., Madrid, Spain (culture isolated in their laboratories). Sample 5 was prepared in our laboratories from the Spanish culture; this was the sample used for purification studies.

Table 6. Comparison of chromatographic and countercurrent distribution fractions of grisein.

Fraction tube Nos.	Wt. of residue (mg)	Activity (unit/mg)	Components by paper chromatogram	Optical absorption	
				$\lambda_{max.}$ (A)	$E_{1\,cm}^{1\%}$
29–46*	51.3	100,000	A	2650	96
				4200	20
47–65*	38.4	20,000	A, B		
71–110*	91.8	72,000	A, B, C	2750	87
				4300	20
111–150*	49.3	40,000	A, B, C	2750	76
				4300	12
Plates					
7–10 ($K = 0.26$)†		80,000	A	2650	70
				4200	18
34–39 ($K' = 18$)†		inactive	D	2750	80

* Data on chromatographic column eluate described in Fig. 1.
† Fractions from a 39-plate countercurrent distribution of grisein (41,000 unit/mg).

Table 7. Data on fractions obtained by repartition of component C (described in Fig. 2).

Fraction tube Nos.	Wt. of residue (mg)	Activity (unit/mg)	Components by papergram
200–210	15.8	180,000	A
216–227	12.3	90,000	A*
239–260	14.8	80,000	A*, C
272–350	36.2	90,000	A*, C

* Components A and B were not clearly resolved on these paper strips.

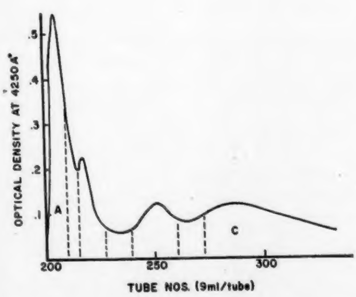

Fig. 2. Repartition of grisein component C. The curve shows the ultraviolet absorption at 4250 A of 9-milliliter aliquots eluted from a cellulose column that was charged with grisein C (60,000 units per milligram).

rial, and component D was not eluted from the column. Determinations of weight, activity, and optical absorption characteristics were made on the lyophilized fractions, and these data, together with the results of paper chromatography, are presented in Table 6. Data from a countercurrent distribution of grisein are included in Table 6 for comparison with the fractions obtained by column partition. The fractions which are composed of component A or D behave as single antibiotic substances on paper chromatograms. However, the B and C antibiotic components obtained in fractions from column chromatography segregate further when they are subjected to paper chromatography.

Repartition on a cellulose column of the fractions that contained mainly component C (tubes 71 to 150) gave the absorption data recorded in Fig. 2. Other data obtained on the peak fractions are included in Table 7. Repartition of component C resulted in separation of other grisein components from C. The highest peak representing the purest material was again component A. The A component behaved on paper strips as a single substance, whereas the C component again segregated into both the A- and C-type antibiotics.

An area 1 centimeter wide was cut from the exact center of the visible orange spot corresponding to antibiotic component C resulting from paper chromatography of 500 micrograms of fraction 272–350 and was suspended in 0.5 milliliter of water. Restripping of 0.01 milliliter of this component on paper, followed by bioautographing with *Escherichia coli* W again showed the segregation of the antibiotic activity into approximately 30 percent component C and 70 percent A and B. It is concluded from these results that component C is converted partly to a more stable form, A, by the step of cellulose column or paper chromatography with *n*-butanol, acetic acid, and water development systems.

Infrared spectra have been obtained on albomycin and on grisein of activity 300,000 units per milligram. The results are consistent with the interpretation that albomycin and grisein are related compounds, taking into consideration the differences in purity of the two materials. The spectra indicate the presence of the same functional groups in each substance.

Summary

Albomycin and grisein were found to be composed of four antibiotically active substances of which A, a strongly active component, and D, a very weakly active component, appear to be stable to purification, while C has been observed to break down continually with concomitant appearance of more A. On the basis of published reports and of studies made in our laboratories, it is concluded that albomycin and grisein are chemically very similar and identical with respect to antimicrobial activity (5).

References and Notes

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3. F. A. Kuehl *et al.*, *J. Am. Chem. Soc.* 73, 1770 (1951).
4. L. P. Garrod and P. M. Waterworth, *Brit. Med. J.* 1956, II, 61 (1956).
5. We are indebted to F. A. Kuehl and N. R. Trenner for making available some chemical data and to B. M. Frost for the antibacterial tests reported in Table 2.

News of Science

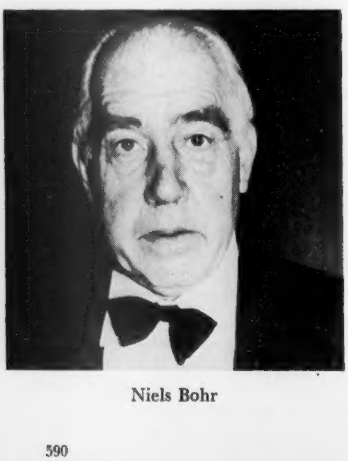
Bohr Wins $75,000 Atoms for Peace Award

Niels Bohr, Nobel prize winner and since 1920 director of the Institute for Theoretical Physics at Copenhagen, Denmark, has been named the first winner of the $75,000 Atoms for Peace Award. Bohr, one of the founders of modern atomic theory, was the unanimous choice of the board of trustees of Atoms for Peace Awards, Inc., according to its chairman, James R. Killian, Jr., president of Massachusetts Institute of Technology. Killian said of Bohr: "By his example he has inspired scientists everywhere to seek out science as an instrument for human welfare."

In a telegram to Killian, President Eisenhower commended the awards committee on its choice. The telegram said, in part:

"Seldom has a man dedicated himself more single mindedly to the search of knowledge for the benefit of mankind than has Professor Bohr in his half-century as a scientist and teacher. The distinction you have conferred on him will offer hope and encouragement to men everywhere in the world who hold that science can be made to serve the hopes of mankind and help bring peace to the world."

Professor Bohr won the Nobel prize in physics in 1922 for theoretical work on the structure of the atom and the basic concept of quantum physics. He played a role in the development of the atomic bomb.



Niels Bohr

The Atoms for Peace awards were established in 1955 through a grant of $1 million by the Ford Motor Company Fund. The awards are intended as a memorial to Henry and Edsel Ford.

Sloan Foundation Basic Research Program

With the approach of the second anniversary of the Sloan Foundation's Program for Basic Research in the Physical Sciences, first announced by Alfred P. Sloan in May 1955, it seems useful to review the plans and procedures of the program. The objectives of the program are to stimulate a greater national effort in truly fundamental research and to emphasize some of the conditions that are essential for such research. Those who designed the program recognize the need for focusing much more attention in the future upon the capability or creative potential of the investigator and upon the importance of giving to him the maximum degree of freedom if he is expected to work on the fringes of man's knowledge.

Perhaps the most nearly unique feature of the present program lies in the fact that research projects are neither solicited nor supported, and no mechanism has been established for the evaluation of research proposals. Instead, unencumbered grants are made available to selected individual scientists who satisfy certain conditions as outlined below. It is in the selection of these scholars that the foundation and its advisers exercise their major responsibility.

Who will be supported? Universities no longer hold a monopoly in the field of pure research. A few industrial laboratories have become world famous through their contributions to fundamental knowledge in the physical sciences. Traditionally, however, investigations directed toward a more profound understanding of natural phenomena have found their home in universities. Consequently, only persons who hold regular faculty appointments in recognized colleges and universities, and whose research interests lie in the basic physical sciences, are eligible for support under the Sloan program. The term "basic physical sciences," as employed here, includes: chemistry, mathematics, physics, and closely related disciplines (that is, astrophysics, geochemistry, and so forth).

In making selections, preference will be given to younger people who are in the early stages of their academic careers. However, occasionally a research grant will be made available to a more mature faculty member when an unusual situation arises. Although the program is essentially national in character, foreign scholars and particularly those associated with Canadian and Mexican institutions are not excluded.

Those responsible for selecting recipients will address themselves primarily to three questions: (i) In the opinion of distinguished scientists, has the candidate demonstrated real potential as a creative investigator? (ii) Do his accomplishments, to date, suggest promise of unusual opportunities for professional growth? (iii) Are his efforts to do fundamental research of his own choosing hampered by a lack of unencumbered funds?

How are candidates found and selected? The foundation has no intention of merely playing a judicial role in evaluating prospective candidates whose names are brought to its attention. It accepts the responsibility of *finding* persons considered to be most worthy of support.

To this end, a Program Committee, whose membership will ultimately be rotated, has been established. Five internationally known scientists—two chemists, two physicists, and one mathematician—constitute the present committee: A. C. Cope, of Massachusetts Institute of Technology; J. B. Fisk, of Bell Telephone Laboratories; K. S. Pitzer, of the University of California, Berkeley; Frederick Seitz, of the University of Illinois; and A. W. Tucker, of Princeton University.

This committee serves the foundation in a dual capacity. In the first place, its members, through their extensive associations with the nation's scientific leaders, aid in the search for potential candidates. Second, the committee serves in an advisory capacity and makes recommendations, through the program administrator, to the foundation's trustees.

Usually, nominations of candidates will be made by one of the nominee's own academic colleagues who is acquainted with his research ability and potential for growth; however, letters of nomination should not be restricted to members of the nominator's own departmental faculty or university. Such letters and other pertinent correspondence

should be addressed to Dr. Richard T. Arnold, Program Administrator, Basic Science Program, Alfred P. Sloan Foundation, Inc., 630 Fifth Ave., New York 20, N.Y.

Faculty members receiving grants under this program are designated as Alfred P. Sloan research fellows. The foundation does not wish to infringe upon the academic prerogatives of its research fellows and, as a matter of policy, agrees that they should (i) choose, without approval, the scientific problem for investigation, (ii) direct its progress, and (iii) select both the appropriate time and place for the publication of results.

Perhaps the reader has already concluded that these grants have somewhat the aspect of an award. While this is true, it should be stressed that the grants are not rewards for past achievements, but are given in the hope that they will help broaden the base of pure research and stimulate an even greater degree of creative thinking in the fundamental sciences.

How are grants negotiated? All grants are negotiated with the appropriate college or university. The funds thus made available are spent at the discretion of the scientist being supported but in accordance with the established policies of his institution. All equipment and supplies purchased under these grants become automatically the property of the institution with which the grant is negotiated. In addition, the foundation attempts to defray, in a realistic manner, indirect costs to the institution that accepts the grant.

Typically, initial grants will be made for a period of 2 years, and these may be continued for a year or two. In order to prevent having funds "spent under pressure," as an alternative to returning unexpended balances to the foundation, an effective scheme has been devised whereby unspent and uncommitted balances remaining on the terminal date of a grant may be carried forward.

Size and growth of the program. At the outset in 1955, a program was envisaged which would ultimately have an annual value of approximately $500,000. During the 2-year period 1955–57, some 75 grants were negotiated in the amount of approximately $650,000.

In the course of the first year's operation, however, it became increasingly apparent that the need for unencumbered research funds in support of highly talented individuals doing fundamental research warranted a substantial increase in the size of the program. This matter is currently under discussion in the foundation. For the year 1957–58, 76 grants, totaling some $600,000, have been approved by the trustees.

Money alone, in spite of the current need for much more of it, will not make a university great. Indeed, unless certain basic conditions obtain its effect can be deleterious [P. E. Klopsteg, "How shall we pay for research and education?" *Science* **124**, 965 (16 Nov. 1956)].

In formulating policies for this program, an attempt has been made to make funds available in such a way as to preserve the integrity of educational institutions and to respect the academic prerogatives and freedoms so essential to a scholar if his research efforts are to be commensurate with his innate capacity to do creative thinking. The responses to the program, to date, have been most gratifying and reassuring.

RICHARD T. ARNOLD
Alfred P. Sloan Foundation, Inc.
630 Fifth Avenue, New York, N.Y.

N.Y. Experiment Station Anniversary

The 75th anniversary date of the organization of the New York State Experiment Station at Geneva was 1 Mar. A unit of Cornell University and the State University of New York, the station plans to celebrate the anniversary by special events throughout the year. The station was among the first half-dozen agricultural research institutions established with public support; now every state in the Union has at least one experiment station.

Australian Physicians Plan Visit to Chinese Mainland

Leonard Cox, an Australian neurologist, who is also an authority on Chinese ceramics, visited China last May. He is seeking to arrange a visit of leading Australian physicians for an inspection of Chinese medical facilities in Peking, Shanghai, and Nanking. Cox reports that many young Chinese physicians desire graduate work in English-speaking countries. The Chinese research institutes are active, particularly in the field of tropical medicine. Cox also reports that the Peking Union Medical College Library remains intact, and is widely used.

Among those who may take the spring trip from Australia to China are the following, all from Melbourne: John Lindell, chairman of the Victorian Hospital, Melbourne; Peter MacCallun of the Cancer Council; S. Sunderland, dean of the Melbourne Medical School; T. Travers, ophthalmologist; Clyde Fitts, internist; Charles Osborn, surgeon; Howard Williams, pediatrician; and S. Houseman, anesthetist. From Canberra, Frank Fenner, professor of microbiology, is expected to be included. A group from Sydney will consist of Edward Ford, dean of the faculty of medicine, University of Sydney; I. D. Miller, neurologist; Eric Clarke, physician; J. Chesterman, gynecologist; and H. C. Barry, orthopedic surgeon.

Synthetic Penicillin

The chemical synthesis of penicillin, which for years has been one of the most baffling problems in chemistry, has been accomplished at Massachusetts Institute of Technology by John C. Sheehan, professor of chemistry, and K. R. Henery-Logan, research associate. Ten new kinds of the synthetic penicillin are now being tested for possible medical use. While the new chemical method probably will not be economical enough to compete with the established fermentation process by which penicillin is derived from molds, it is hoped that new forms will prove effective against disease organisms now resistant to natural penicillin and against a wider variety of infections. New penicillins might also have less tendency to produce allergic reactions.

The penicillin molecule is not an unusually complex one. Similar molecules, such as those of quinine, morphine, cortisone and sucrose, had yielded to synthesis. But the penicillin molecule is unstable and disintegrates easily—especially at one point in the process.

During World War II, it is estimated a thousand chemists worked in 39 laboratories in the United States and Great Britain in the attempt to synthesize penicillin. One group did succeed in producing a microscopic quantity but the process was not a methodical one and practical production was out of the question. At that time, the structure of the molecule was not thoroughly understood.

Sheehan undertook the task in 1948, and, with the help of graduate and post-doctoral students, continued the laboratory work for nearly 9 years. Final results have been announced in the 11 Mar. issue of the *Journal of the American Chemical Society*.

The Sheehan process employs reactions and technology which are expected to be useful in solving other chemical problems. It consists chiefly of a series of reactions at room temperature or below. The crucial step occurs when a carbon atom is bonded to a nitrogen atom, completing the structure of the final product, phenoxymethylpenicillin, which is known as penicillin V, the antibiotic which is commonly administered by mouth.

The research has been aided financially by Bristol Laboratories of Syra-

cuse, N.Y. Medical research is being conducted by Merck, Sharp and Dohme Research Laboratories at Rahway, N.J., where the ten new types of the synthetic penicillin were prepared. These types are all antibiologically active and could not have been obtained through the fermentation process. They are being tested on animals.

Fellowships in Psychiatry

The American Psychiatric Association has announced that the next review of applications for Smith, Kline and French Foundation fellowships in psychiatry will be held in May. Applications must be received *before 15 Apr.* by the Fellowship Committee, P.O. Box 7929, Philadelphia, Pa.

Seven chief types of Smith, Kline and French Foundation fellowships are available: (1) support for advanced training for full-time staff psychiatrists of public mental hospitals and schools for the retarded; (ii) awards to hospitals for visiting lectureships and for teaching fellowships; (iii) support for medical schools, teaching centers, and so forth, for extension training programs; (iv) student fellowships to encourage talented medical students to engage in summer activities in psychiatry (the aim here is not only to draw more students into psychiatry as a life work, but also to expand the psychiatric knowledge of those who plan to enter other fields); (v) medical fellowships to encourage broadened skill in psychiatric problems of everyday practice by physicians other than psychiatrists; (vi) foreign scholar lectureships to bring outstanding men to the United States; and (vii) residency training fellowships under unusual circumstances.

U.N. and Medical Irradiation

A recent statement by the United Nations Scientific Committee on the Effects of Atomic Radiation about the responsibilities of the medical profession in the use of x-rays and other ionizing radiation ends with the following summary.

1) The Scientific Committee on the Effects of Atomic Radiation established by the United Nations General Assembly accepts the view that the irradiation of human beings, and especially of their germinal tissue, has certain undesirable effects.

2) Information received so far indicates that, in certain countries (Sweden, United Kingdom, United States of America), by far the most important artificial source of such irradiation is the use of radiological methods of diagnosis and that this may be equal in importance to radiation from all natural sources. It is possible that such radiation may be having a significant genetic effect on the population as a whole.

3) The committee is fully aware of the importance and value of the medical use of radiations but wishes to draw the attention of the medical profession to these facts and to the need for a more accurate estimate of the amount of exposure from this source. The help of the medical profession would be most valuable to make it possible to obtain fuller information on this subject.

4) The committee would be particularly grateful for information through appropriate governmental channels on ways in which the medical irradiation of the population can be reduced without diminishing the true value of radiology in diagnosis or treatment.

John Mayor Appointed

The board of directors of the AAAS announces the appointment of John R. Mayor to the newly established position of director of education. Since September 1955, Mayor has served on the association's staff on a temporary appointment as director of the Science Teaching Improvement Program that is financed by a grant from the Carnegie Corporation of New York. The new appointment reflects a decision of the board of directors that active effort to improve the teaching of science and mathematics should constitute a major and continuing part of the association's program.

The direction of work in science education calls for a thorough acquaintance with both science and education. Mayor has both. His doctorate was in mathematics; his first major position was as chairman of the department of mathematics at Southern Illinois University; from 1947 to 1955 he was associate professor and professor of mathematics at the University of Wisconsin. Early in his career he developed an interest in the education of teachers of mathematics, and at the University of Wisconsin he held appointment in the department of education as well as the department of mathematics. At Wisconsin he also directed the work in mathematics at the university high school and for 1954–55 served as acting dean of the school of education.

The association's activities in the field of science teaching were described at the time of Mayor's original appointment [*Science* **122**, 145 (22 July 1955)]. The new appointment means that those activities can be continued under permanent and excellently qualified guidance. —D. W.

Tubercle Bacillus Anniversary

Seventy-five years ago this month the first description of the rod-shaped microorganism which is the specific cause of tuberculosis was given the world. The story of Robert Koch's isolation of the tubercle bacillus and how he proved, in a paper read before the Berlin Physiological Society on 24 Mar. 1882, that it was the cause of tuberculosis is told in the March issue of the *Bulletin* of the National Tuberculosis Association.

The organisms that Koch described are from 1/5000 to 1/6000 of an inch long and approximately 1/25,000 of an inch wide. Yet, as the *Bulletin* article points out, they are made up of protein, fats and waxes, and carbohydrates. "Their chemical composition is extremely complex, and despite the fact that for 75 years we have known how to isolate the tubercle bacillus and to grow it under artificial conditions, we still do not understand it well enough to know why it has such a predilection for human tissue and why it is so difficult to kill it in the human body without hurting the tissue itself."

Puerto Rican Health

Puerto Rico's effective health and sanitation campaign has lowered its death rate to 7.2 per 1000. This is two points lower than the United States figure.

As recently as 1940, life-expectancy in Puerto Rico's slums and farm villages was 46 years. Today, it has been raised to 68. Infant mortality, malaria, and tuberculosis all have been reduced drastically.

The main factor in this transformation has been the island's intensified health and hospital program. Since 1948, 24 health centers, a 1000-bed psychiatric hospital, and an 800-bed tuberculosis sanatorium have been constructed. The island now has 12,096 hospital beds and a $34-million budget for the Department of Health for the current fiscal year.

To staff these facilities, the University of Puerto Rico's medical school is turning out more than 50 scholarship graduates a year who are obliged to work 1 year in the Department of Health for every year they receive government financial aid to complete medical school.

April Scientific Monthly

Articles appearing in the April issue of *The Scientific Monthly* are: "Ecology and overpopulation," L. R. Dice; "Thomas Henry Huxley," C. F. Blinderman; "Genetics in animal breeding," I. M. Lerner; "When is human behavior predetermined?" E. G. Boring. Eight books are reviewed. The issue also contains a "Letters" section and an "Association Affairs" section.

Proposed Legislation

Of the many bills introduced in Congress, some have a special relevance to science and education. A list of such bills introduced recently follows:

HR 3120. Provide for establishment of Bureau of Older Persons within Department of Health, Education and Welfare; authorize Federal grants to assist in development and operation of studies and projects to help older persons. Wier (D Minn.) House Education and Labor.

HR 2803. Establish a system for classification and compensation of scientific and professional positions in Federal Government. Gubser (R Calif.) House Post Office and Civil Service.

HR 2767. Amend. sec. 161 of Revised Statutes re authority of Federal officers and agencies to withhold information and limit availability of records. Moss (D Calif.) House Government Operations.

HR 2522. Authorize extension of patents covering inventions whose practice was prevented or curtailed during emergency periods by service of patent owner in Armed Forces or production controls. House Judiciary.

HR 3015. Provide for gradual elimination of salmon traps in waters of Alaska. Bartlett (D Alaska) House Merchant Marine and Fisheries.

Scientists in the News

RICHARD L. KIRK has been appointed by the Atomic Energy Commission as assistant director for international organizations of the Division of International Affairs. He will be responsible to the division director, John A. Hall, for technical advice and support of the U.S. representative on the Preparatory Commission of the International Atomic Energy Agency and will participate in formulation of policies covering U.S. participation in the agency when it is established. He will have similar duties on matters relating to other international multilateral organizations and groups.

Kirk has been in the atomic energy program for 12 years, serving at Oak Ridge, Tenn., and New York City in the fields of production of source and fissionable material and in weapons development and manufacturing. Since September 1956, he has participated in the development of AEC policy on various international programs.

C. H. B. PRIESTLEY, chief, Division of Meteorological Physics, Commonwealth Scientific and Industrial Research Organization, Victoria, Australia, recently visited the departments of meteorology and engineering at the University of California, Los Angeles. During his visit, Priestley gave a public lecture on "The vertical transport of heat, moisture, and momentum from the ground," and two seminars on "Convection from the earth's surface: (i) heat transfer by free and forced convection; and (ii) properties of turbulence and convective motions."

RENÉ SPITZ has been appointed visiting professor in psychiatry at the University of Colorado School of Medicine, effective 1 Apr. He will continue his research in infant observation as well as his clinical and teaching activities.

J. WILLIAM HINKLEY has succeeded JOSEPH W. BARKER as president and chief executive of the Research Corporation. Barker will continue as chairman of the board.

The Research Corporation is a nonprofit foundation founded in 1912 to support scientific research in colleges, universities, and scientific institutions. Its income is derived from the administration of inventions made in colleges and universities throughout the country and from its subsidiary, Research-Cottrell, Inc., manufacturer of Cottrell precipitators and other industrial gas-cleaning equipment.

Hinkley joined Research Corporation in 1944 as manager of the Cambridge, Mass., division. In 1955 he was named executive vice president. Barker has been president and board chairman since 1946. From 1930 to 1946 he was dean of engineering at Columbia University and served as special assistant to the Secretary of the Navy from 1941 to 1945. During 1956 he was president of the American Society of Mechanical Engineers.

The 11th annual Viking Fund medals and awards of $1000 each, which are sponsored by the Wenner-Gren Foundation for Anthropological Research, were presented on 1 Mar. as follows.

FRED R. EGGAN, of the University of Chicago, received the Viking Fund medal in general anthropology upon selection by the American Anthropological Association; JUNIUS B. BIRD, of the American Museum of Natural History, was chosen to receive the Viking Fund medal in archeology by the Society for American Archaeology; and MILDRED TROTTER, of Washington University, St. Louis, was the recipient of the Viking Fund medal in physical anthropology, upon nomination by the American Association of Physical Anthropologists. She is the first woman scholar ever to receive a Viking Fund medal.

ARVID WALLGREN of Stockholm, Sweden, internationally known pediatrician, will lecture on BCG at the closing session of the 53rd annual meeting of the National Tuberculosis Association on 9 May in Kansas City, Mo. Wallgren is coming to this country at the invitation of the Potts Memorial Institute to give the Charles J. Hatfield memorial lecture.

The NTA meeting and that of its medical section, the American Trudeau Society, will open on 6 May, in the Municipal Auditorium in Kansas City. The J. Burns Amberson lecture, named in honor of the former head of the chest service at Bellevue Hospital, New York, N.Y., will be given by RICHARD L. RILEY of Johns Hopkins University, whose subject will be on "Aerial dissemination of pulmonary tuberculosis."

DEAN AMADON has been named chairman of the department of birds at the American Museum of Natural History, New York. Amadon, who assumes the position formerly held by the late John Todd Zimmer, is also Lamont curator of birds at the museum. As chairman of the bird department, he will head an outstanding ornithological research center and will also be responsible for the supervision of one of the two largest collections of birds in existence. The museum's collection now numbers more than 800,000 specimens from all parts of the globe.

CHESTER M. McCLOSKEY, a chemist who has been chief scientist of the Office of Naval Research in Pasadena, Calif., since 1955, has been appointed executive director of the Industrial Associates of California Institute of Technology. He succeeds ROBERT V. BARTZ, who recently accepted a position in Washington with the Institute for Defense Analyses, of which Caltech is a sponsoring institution.

The Industrial Associates program was established at the institute in 1949. Its members are 41 large national corporations, each of which contributes $10,000 a year to the institute on an unrestricted basis (three companies give larger sums). In recognition of these contributions, the institute provides technical conferences

for representatives of the companies, sends faculty members to visit company laboratories, and supplies the companies with progress reports on the institute's research programs. It also provides them with prepublication abstracts of articles for technical journals, abstracts of theses, annual reports from the technical divisions of the institute, and advance notice of all general and technical meetings on campus. In addition, research people from the affiliated companies are welcomed to the campus for individual study programs.

SYDNEY GELTMAN, a theoretical physicist who has been associated with the Johns Hopkins University Applied Physics Laboratory, has joined the staff of the Atomic and Radiation Physics Division of the National Bureau of Standards, Washington, D.C. He will deal with theoretical aspects of the bureau's experiments in such areas as the photodetachment of electrons from negative ions and the mobility of positive ions in gases. He will also conduct independent theoretical investigations into fundamental atomic processes, for example, those that occur in gaseous discharges or upper atmospheric phenomena.

The John Jay Hopkins Laboratory for Pure and Applied Science of General Dynamics Corporation's General Atomic Division, San Diego, Calif., has announced the following new appointments: two mechanical engineers, HEINZ POPPENDIEK of Oak Ridge National Laboratory and DAVID NICOLL of Argonne National Laboratory; two nuclear physicists, JOHN R. BEYSTER of the Los Alamos Scientific Laboratory and ROBERT B. MINOGUE of the Reactor Development Division of the U.S. Atomic Energy Commission and the Nuclear Propulsion Divisions of the U.S. Navy's Bureau of Ships; and a health physicist, WILLIAM RAY, for the past year a radiological health training officer at the U.S. Public Health Service's Robert A. Taft Sanitary Engineering Center in Cincinnati, Ohio.

JOHN CHIPMAN, professor and head of the department of metallurgy at Massachusetts Institute of Technology, is giving the annual Priestley lectures at the Pennsylvania State University. This is the 31st year of the lectures, which are sponsored by Mu Chapter of Phi Lambda Upsilon, honorary chemistry fraternity, as a memorial to Joseph Priestley. This year's series of five lectures will be given on succeeding days, commencing 1 Apr., on the general topic "Chemistry in the metallurgy of iron and steel." As in the past, the lectures will be published and sold by Phi Lambda Upsilon to help defray expenses.

ROBERT W. CAIRNS, director of Research for the Hercules Powder Company, has been appointed chairman of the Advisory Panel on General Sciences of the Office of the Assistant Secretary of Defense for Research and Development. The general sciences panel was established "to insure that the nation's best scientific and technical talents are applied to the planning and prosecution of the military research and development programs on general sciences."

Members of the panel consist of the nation's top civilian scientists and experts, most of them in universities and colleges and some with industry. The responsibility of the panel will be the development of technical advice and guidance on the basic research programs of the Department of Defense in the geophysical, physical, engineering, and biological sciences.

With this appointment, Cairns also becomes a member of the Defense Science Board, a group of 25 leading scientists and engineers representing various technical areas and organizations, such as the National Academy of Sciences and the National Advisory Committee for Aeronautics. The board was set up by the Assistant Secretary of Defense as a result of a recommendation of the Hoover Commission on Organization of the Executive Branch of the Government. Its task is to delineate scientific opportunities which hold promise of radically outdating present-day concepts of warfare and to advise on the effectiveness of research and development in providing new weapons systems.

JOHN M. WEST, former associate director of the Reactor Engineering Division of Argonne National Laboratory and project manager of the laboratory's recently dedicated 5000-kilowatt nuclear power plant, has been appointed vice president of the General Nuclear Engineering Corporation, Dunedin, Fla. The corporation was formed in 1956 for the purpose of providing engineering services in connection with the design, construction, and operation of nuclear reactors for use in electric generating stations, medical centers, educational institutions, and research laboratories. Walter H. Zinn, former director of Argonne National Laboratory, is president of the firm.

ROBERT ANNAN, internationally known mining engineer and chairman of the Consolidated Gold Fields of South Africa, Ltd., of England, has been named 1957 recipient of the Egleston medal, Columbia University's highest award for distinguished engineering achievement. The medal will be awarded to Annan at a dinner at the Columbia University Club in New York on 9 May.

PIERRE MOREL has been named scientific attaché for the Cultural Services Division (New York) of the French Embassy. He succeeds ANDRÉ GAUVENET. Morel's principal research has been in the field of solid-state physics and semiconductors.

JOHN L. HOLLAND, formerly chief of the Vocational Counseling Service and staff clinical psychologist at the Veterans Administration Hospital, Perry Point, Md., has been appointed director of research for the National Merit Scholarship Corporation, Evanston, Ill.

HARRY WILLIAMSON, formerly assistant to the director of the Division of Applied Biology, National Research Council of Canada, has been named scientific liaison officer in Washington, D.C. for the Canadian NRC. In cooperation with the Department of External Affairs, he will act as scientific attaché at the embassy.

Recent Deaths

CHARLES S. GLEIM, Wilton, N.H.; 69; consulting engineer for the Port of New York Authority; 10 Mar.

GUNTER H. GLOSS, Mundelein, Ill.; 45; supervisor of inorganic chemical research for International Minerals and Chemical Corporation; 24 Feb.

WALTER E. HADLEY, Hancock, N.H.; 76; charter member and first national secretary of the American Association of Textile Chemists and Colorists; 7 Mar.

BRADLEY JONES, Cincinnati, Ohio; 68; head of the department of aeronautical engineering at the University of Cincinnati who established the cooperative program in aeronautical engineering at the university; 8 Mar.

ALBERT KUNTZ, Saint Louis, Mo.; 77; director of the department of anatomy at Saint Louis University School of Medicine; 19 Jan.

ROBERT L. LUND, St. Louis, Mo.; 81; former president of the St. Louis College of Pharmacy; 9 Mar.

NICHOLAS E. OGLESBY, Troy, N.Y.; 64; chemist and director of pattents and licenses for the Behr Manning Company; 8 Mar.

DOUGLAS J. ROBERTS, Vernon, Conn.; 64; president elect of the American Radium Society; 12 Mar.

JOHN B. SUTTON, Shreveport, La.; 38; former member of the faculty at the University of Alabama Medical School; 8 Mar.

***Erratum*: The chairman of this year's Gordon Research Conference on Lipide Metabolism at Kimball Union Academy is Cecil Entenman, not Warren M. Sperry as stated in the issue of 1 March, p. 408.**

Reports

Biological Equilibrium and the Origin of Cancer

Many biological variations that have occurred in a rather extensive series of experiments dealing with maternal age and characteristics of the offspring are quite unpredictable and, at least, partially unexplainable. These characteristics have involved susceptibility to various types of chemically induced neoplasias (*1–3*) as well as characteristics of a biological or physiological nature, such as age of first litters, litter spacings, litter sizes, and so forth.

The first unusual variation that occurred was the appearance of chemically induced neoplasias (methylcholanthrene was used) in mice of the Br descent at earlier and earlier latent periods in spite of the fact that a continuous selection toward resistance to tumors had been employed. The phenomenon of variation taking place counter to the trend of genetic selection was later verified in the 2NHO descent (*1*). "In this series a total of 3247 mice of the 2NHO descent have been injected subcutaneously with one milligram of methylcholanthrene at sixty days of age. The mice belonged to the F_1–F_{20} generations. A selection toward resistance to all chemically induced tumors was constantly employed. Fibrosarcoma at the site of the carcinogen and lung adenomas appeared to respond to selection between F_1–F_4. However, beginning with F_5 there was a reversal of susceptibility to these two tumors in spite of selection toward greater resistance. Adenomatous lesions near the pylorus and papillomas of the forestomach appeared in mice only during the intermediate generations F_3–F_{14}. Following a period of delayed latency for the appearance of fibrosarcomas as a result of selection toward resistance to such tumors, there was a progressively earlier appearance of such tumors counter to the trend of selection providing methylcholanthrene had been injected into both parents over many generations. This phenomenon of reversed susceptibility to induced tumors has occurred in *all* selected lines and must be considered the rule."

Another unexpected observation was that the latent period for the appearance of any specific type of tumor could not be increased by genetic selection toward resistance to chemically induced tumors; what actually occurred as a result of this method of selection was that one type of tumor was replaced by another histologically different tumor with a longer latent period (*2*). This study also led to the observation that, between the F_4 and the F_{20} generations of the pBr descent, the sum total of chemically induced tumors (percentage incidence) did not change—there was merely a shift in the histological types of tumors. The conclusion was reached that "in the genetic mechanisms involved in cancer, perhaps one or more factors control the origin of specific types of tumors, whereas another mechanism may be involved in the origin of the total number of tumors (all tumors at all sites taken together)."

Selection toward an earlier and earlier litter seriation descent (early maternal age) has also produced variation in the opposite direction of all specific types of tumors investigated: (i) squamous cell carcinoma of the skin, (ii) adenocarcinoma of the lungs, (iii) fibrosarcoma, (iv) adenocarcinoma of the mammary gland, (v) mixed tumors, and (vi) rarer tumor types at other sites (*3*).

The same phenomenon that variations sometimes take place counter to the trend of genetic selection has occurred several times in a polydactylous descent that was started in the F_1 generation of a cross between mice and the C_{57} blacks and the Brpb descent and has continued, up to the present time, to the F_{17} generation.

In this experiment (*4*), six separate descents have been continued. The selection has been based exclusively on maternal age—that is, the time at which the offspring were born. The classes are (i) less than 100 days, (ii) 101 to 200 days, (iii) 201 to 300 days, (iv) 301 to 400 days, (v) 401 to 500 days, and (vi) 501 to 600 days; each generation has been made up of at least 30 breeding brothers-to-sisters. One of the ideas behind this investigation was to determine the maximal variation possible by brother-to-sister matings beginning with the F_1 generation (high heterozygosity) and continuing until a high degree of homozygosity had been reached. Eventually the process of selection, now based on maternal age exclusively, will be reversed in order to determine whether any divergence in the present six independent descents is permanent or only of a temporary nature. Reversed selection is not indicated, however, until proof that biologic equilibrium for any character has been obtained.

The average ages for the production of first litters for the six "maternal-age" descents between F_1 and F_{17} have been in sequence 82.1, 73.9, 72.2, 68.8, 64.7, and 51.5 days. This again is variation counter to the trend of selection, the youngest maternal-age descent having their first litters later than females in the other older maternal-age descents.

The average litter spacings between the first and eighth litters (both sexes being kept together in all cases) have been in the six maternal-age descents, 28.5, 27.7, 27.7, 26.8, 27.0, and 24.4 days. This is a regression (straight line) curve, although with small slope counter to the trend of selection.

The average litter spacings for the same six maternal-age descents in sequence between the eighth and 14th litters have been 22.7, 23.9, 24.3, 25.1, 24.1, and 30.6 days.

Thus mice of the earliest maternal-age descent (less than 100 days) have their first litters later than do females of the other maternal-age descents; they have the poorest litter-spacings value in the early litters, but they improve in this characteristic between the eighth and 14th litters more than do females of the other four maternal-age descents. Mice of all separate maternal-age descents have their 14th litters at approximately the same age. In sequence, the average ages of mice for the birth of 14th litters were (i) 412.7 days, (ii) 411.7 days, (iii) 412.1 days, (iv) 408.3 days, and (v) 403.0 days.

The litter size of mice again demonstrates a compensatory mechanism. In the F_2 generation, the average litter size increased in all six maternal-age descents up to a maximal value in the fifth litter and then decreased until the lowest value was obtained in the last litter born to any female (in the 20th litter in the F_2 generation).

The descendants that are selected in

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

an early litter (that is, at an early maternal age) descent when the litter size is maximal have smaller litters than do the females that were taken from a late litter (or late maternal age) descent where the litter size had been minimal. Here again is evidence of a compensatory mechanism influencing litter size.

It is clear by the evidence now available that the characteristics of the offspring occurring in the maternal-age descents in the middle of the age distribution do not significantly change between the F_1 and F_{10} generations—it is only the offspring of the two extreme maternal-age classes which deviate, and this deviation is counter to the trend of maternal-age selection.

The obvious reason for such compensatory changes as those enumerated in the preceding pargraphs is to keep the species in equilibrium. If there were no such compensatory mechanism, it would be relatively easy for a species to drift into chaos. This would necessarily be so for any character that may be partially influenced by parental age and other factors. If the practice were continued for many generations for females to have their first child (or litter) earlier and earlier, irreparable damage to the species might be the result. Similarly, the practice of bearing young long after the normal reproductive period has been exceeded might also produce disastrous results.

The present experiment indicates quite convincingly that, unless the insult has not been too great for too many generations, a compensatory mechanism corrects for a deviation from the norm, and this variation takes place counter to the trend of selection.

In genetics there is a concept that a species is in equilibrium until a mutation occurs "to upset the applecart," after which a new equilibrium is established by incorporating into, or by discarding from descent, the new mutation. We no longer have to make the assumption that the species is in equilibrium (homeostasis). There is evidence, such as the present data, to prove that a mechanism actually exists. The nature of this mechanism is still in doubt, and we do not know how to influence it.

It is not my intention to review the literature dealing with equilibrium or homeostasis. To me it is not clear whether biological or genetic equilibrium is involved. To some investigators these two phenomena may be absolutely dependent on each other. This may be true, but certainly more data are needed for final analysis. The field of genetic homeostasis has recently been covered by Lerner (5).

Since so many types of biological characteristics, such as age of first litters, litter spacing, litter size, and various types of tumors, are kept in equilibrium, this mechanism must be of extreme biological importance. A species could probably not be kept in equilibrium unless the individuals who make up the species are also in equilibrium at least during the reproductive period.

The various types of cancers which arise in the mammalian body have, at least, one characteristic in common. Cancer arises because the organism has lost control of a definitive part. Perhaps during the aging process the mechanism that keeps the individual in equilibrium is disrupted, and as a result of this loss of control of all the parts cancer of one or more elements is able to originate and to grow at the expense of the rest of the body.

LEONELL C. STRONG

Biological Station,
Roswell Park Memorial Institute,
Springville, New York

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4. This work has been made possible, in part, by a grant from the National Cancer Institute, U.S. Public Health Service.
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15 January 1957

Auditory and Aversion Thresholds of Rats for Bands of Noise

In the context of animal behavior theory, stimuli are often described as having both drive and cue value (*1*). Drive value refers to the ability of a stimulus to motivate behavior, and cue value refers to the ability of a stimulus to serve as a signal to the animal by virtue of its distinctiveness. In general, these two aspects of stimuli have been studied independently within the framework of two separate psychological disciplines, namely, learning theory and psychophysics. As a result of this, there are few studies comparing the cue and drive properties of stimuli, although it is obvious that the two properties are not unrelated in the case of most stimuli.

The purpose of the present study (*2*), then, was to develop a technique for comparing the drive and cue properties of a specific stimulus dimension—in this case, noise. More specifically, this research compares the auditory thresholds of rats for bands of random noise with the aversion thresholds of rats for the same bands of noise. The auditory thresholds were taken to represent the minimal cue value of white noise, and the aversion thresholds the minimal drive properties of white noise. Thresholds were obtained for a number of different frequency bands of noise so that both the shape of the functions and the distance between them could be compared. The following bands of noise were used: 250 to 500, 500 to 1000, 1000 to 2000, 3000 to 4000, and 4000 to 5000 cy/sec.

Acoustically, the apparatus for both threshold studies was the same, consisting primarily of a noise-generating system and a heavy Celotex enclosure 2 ft wide, 3 ft deep, and 6 ft high lined with fiber-glass insulation. The noise-producing system included a white noise generator, electronic switch, audio amplifier, attenuator, two UTC-4C variable bandpass filters, and a horn-type loudspeaker mounted inside the Celotex enclosure. Two test cages were used in the study; one for the determination of auditory thresholds and one for the determination of aversion thresholds. Both cages had the same over-all physical dimensions (7 in. wide, 10 in. deep, and 7 in. high); when in use (one at a time), they were mounted at the midline of the cabinet on steel rods. The sound field within each cage was relatively uniform ($\pm 1\frac{1}{2}$ db for all frequency bands).

Auditory thresholds were determined by means of a classical shock-avoidance technique. Six animals were first trained to turn a small wheel located at one end of the cage whenever a noise stimulus was presented. This was accomplished by giving the animal an electric shock by means of a shock grill floor if it did not turn the wheel within $2\frac{1}{2}$ seconds of the onset of the noise. Whenever the animal responded within the $2\frac{1}{2}$-second period, the noise was turned off and no shock was administered; if the animal did not respond within the $2\frac{1}{2}$-second period, the noise continued and electric shock was administered until the rat turned the wheel. After the animal had been trained to respond to the cue or signal value of the noise, it was possible to determine the auditory threshold by varying the noise stimulus in 5-db steps around the threshold and recording the number of times the animal responded to each intensity. At the lowest intensi-

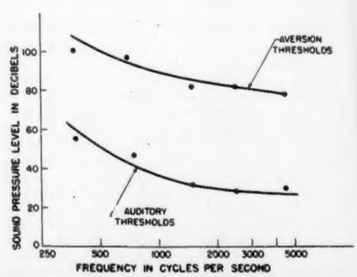

Fig. 1. Auditory and aversion thresholds of rats for bands of noise.

ties of noise used, the animals never responded, while at the higher levels they responded nearly 100 percent of the time. As in psychophysical studies on human subjects, the threshold was defined as the point at which the animal responded 50 percent of the time to the noise stimulus.

The auditory thresholds obtained through this procedure are shown by the lower line in Fig. 1. As can be seen, the threshold decreases as frequency increases within the frequency ranges studied, and the function is quite comparable to threshold functions of rats which have been obtained for pure tones (*3*).

Aversion thresholds for the same bands of noise were obtained by determining the intensity of noise that the animals avoided 75 percent of the time in a simple spatial preference situation. These thresholds were determined in a cage so designed that when the animal was at one end of the cage silence prevailed, but when it moved to the opposite end a specified level of noise came on and stayed on as long as it remained there. If the noise was intense enough, the animal soon learned to avoid the noisy end of the cage and remain at the silent end.

To obtain the aversion thresholds, the relative avoidance of the noisy end was determined for five intensities at each band. These ranged, at all bands, from 65 to 105 db in 10-db steps. Six animals were run at each of these bands of noise, and each animal was tested for its relative avoidance of the noisy end for each of the five intensities during separate 50-minute test periods. Each animal was given a single test period each day, and the order in which it received the noise intensities over the 10-day test period was randomly determined. Any preference for one end of the cage was balanced out by giving the animal each intensity at both ends of the cage on succeeding days.

The noise-aversion thresholds were determined by plotting the animal's avoidance of the noisy end of the cage during the last 30 minutes of the 50-minute trial as a function of sound level. The aversion threshold was defined as the intensity of noise the animals avoided 75 percent of the time, and these points were determined visually for each level from the afore-mentioned functions.

The aversion thresholds for the five bands of noise studied are shown by the upper line in Fig. 1. The form of the aversion-threshold function is much the same as that obtained for the auditory thresholds in that the threshold decreases as frequency increases. The chief difference between the two functions is that the aversion thresholds are some 40 to 50 db higher than the auditory thresholds.

On the basis of these data, it is possible to describe more fully the relationship between the drive and cue values of auditory stimuli for albino rats. For all practical purposes, those stimulus intensities which fall between the auditory and aversion thresholds can be described as having primarily cue value, while those falling at and above the aversion threshold can be considered to have both drive and cue value. This information may serve as a reference for experimental psychologists who wish to select auditory stimuli which are sufficiently intense to serve as distinct cues without being aversive, or to those who wish to select stimuli which are clearly aversive.

BYRON A. CAMPBELL

Department of Psychology, Princeton University, Princeton, New Jersey

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20 November 1956

Antibodylike Factor in Serums of Ragweed-Sensitive Individuals Shown in vitro

Numerous attempts to demonstrate specific antibodies in serums of allergic individuals by *in vitro* methods have been reported in the literature. Although some workers have claimed that they have been able to detect an antibodylike factor by techniques such as the inhibition of complement fixation (*1*) and the clumping of allergen-coated collodion particles (*2*) and erythrocytes (*3, 4*), the results of other workers are contradictory or inconclusive.

In the present study (*5*) the highly sensitive hemagglutination technique, as described recently by Stavitsky and Arquilla (*4*), was shown to lend itself to the clear-cut demonstration of antibodylike factors in serums of untreated and treated ragweed-sensitive individuals (*6*). Rabbit erythrocytes were used for sensitization with a ragweed extract. To 0.1 ml of a 1/1 suspension of rabbit erythrocytes in saline, 3 ml of a 0.5-percent saline solution of water-soluble ragweed extract (WSR) (*Ambrosia artemisiaefolia*) and a bis-diazotized benzidine solution in phosphate buffer was added. All serums, prior to testing, were absorbed with nonsensitized erythrocytes to remove nonspecific agglutinins.

The method was standardized with two precipitating antibody-antigen systems: WSR-rabbit anti-WSR, and BSA-rabbit anti-BSA (bovine serum albumin). Typical hemagglutination patterns are presented in Fig. 1. The high sensitivity of the method as claimed by Stavitsky and Arquilla (*4*) was confirmed (for example, the titer of the rabbit anti-WSR serum was 1/600,000,000). Furthermore, the specificity of the hemagglutination reaction was demonstrated by the inhibition of the test with an excess of the specific antigen. By the use of erythrocytes sensitized with ragweed, positive results were obtained with four serums of treated, and with twelve serums of untreated, ragweed-sensitive individuals in dilutions as high as 1024 and 512 respectively. Thirty normal human serums gave negative results. The positive reactions were shown to be specific for ragweed as demonstrated by the inhibition of the tests with excess water-soluble ragweed extract and not with other antigens, such as bovine serum albumin, grass pollen, and wormwood.

Heating serums of untreated, allergic individuals containing reagin at 56°C for as long as 11 hours did not change their hemagglutination titer, although their skin-sensitizing ability was destroyed. Positive hemagglutination tests were obtained only with serum fractions (separated by starch electrophoresis from two serums of untreated ragweed-sensitive individuals) that also possessed skin-sensitizing activity. However, these findings cannot be taken as evidence that the hemagglutination factor is identical with the skin-sensitizing antibody that is commonly found in allergic serum.

On the basis of these experiments, it seems reasonable to conclude that serums of individuals who are allergic to ragweed contain an antibodylike factor or factors that are demonstrable *in vitro*. These studies would suggest that this system behaves very much like an ordinary

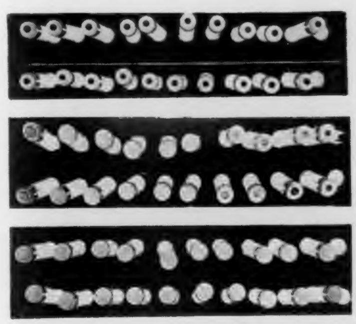

Fig. 1. Hemagglutination patterns. Each row represents tubes containing serum in halving dilutions. The concentration of serum decreases from left to right. (Top pair) Controls using normal human serum. No hemagglutination is observed in any tube. (Middle pair) Allergic serum. The patterns represent a gradual decrease in the extent of hemagglutination. (Bottom pair) Rabbit antiserum. The patterns represent positive results.

antigen-antibody system and that inability to detect these antibodies in the past may be attributed primarily to their being present only in exceedingly small concentrations and not necessarily to their being "incomplete" or "univalent" antibodies (7). Further experiments are planned to elucidate the nature of the hemagglutination factor detected in allergic serums.

A. H. Sehon
J. Gordon
B. Rose

Allergy Research Division, McGill University Clinic, Royal Victoria Hospital, and *Department of Experimental Medicine, McGill University, Montreal, Quebec*

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5. This study was supported by grants received from the Department of Health and Welfare, Canada, and the National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, Md. We wish to thank D. Guérette for her skillful assistance. A full report on this study, including a discussion of its implications, is in preparation.
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27 December 1956

Formation of Lentoids by Dissociated Retinal Cells of the Chick Embryo

The capacity for self-differentiation of the embryonic chick eye has been studied by culturing the excised rudiment or its constituent tissues *in vitro* (*1, 2*), or as chorio-allantoic grafts (*3, 4*). Within the limitations imposed by the experimental conditions, the isolated eye tissues were found to be capable of developing histotypically with a remarkable degree of normality. It was noted, however, that when they were isolated from the ocular environment, some of the tissues occasionally developed in a direction different from that which they originally manifested, being thus able to give rise to more than one of the structural components of the eye. Thus, transformation of retinal tissue into tapetum and transformation of pigmented tapetum cells into sensory retinal cells were observed in cultures and grafts of embryonic chick eye tissues (*2, 4*). Such developmental modifications may be experimentally provoked by damage to the ocular tissues—that is, by a disruption of the existing intercellular and intertissue relationships (*5*). Apparently the effects of this damage and the ensuing processes of repair and reorganization give rise to conditions under which cells may assume a new association with different histogenetic properties and become diverted into an altered developmental course. Recent observations on the behavior *in vitro* of dissociated cells of embryonic chick sensory retina support this possibility; under suitable conditions such discrete cells in suspension aggregated and reestablished tissue continuity, but, instead of resuming their prior development as sensory structures, they frequently formed lentoid tissue.

The neural retinal tissue of 6- or 7-day embryos was stripped out of the dissected eyes. Special care was taken not to include pigmented tapetum cells and to discard the iris with the adjoining retinal tissue. The sheets of sensory retinal cells thus obtained were then dissociated into a suspension of discrete cells by procedures described earlier, based on the treatment of the tissue with cation-deficient solutions and trypsin (*6*). The suspended cells (Fig. 1*a*) were then cultivated *in vitro* under conditions suitable for the formation of aggregates and their differentiation (*6*). Watch-glass cultures of undissociated retinal tissue served as controls.

Dissociated retinal cells aggregated to form rosettes—that is, small groups of cells arranged concentrically around a lumen (Fig. 1*b*). When grown in organ cultures such rosettes continued to develop as a sensory tissue. However, if numerous clusters of rosettes were heaped together and cultured for several days under conditions of overcrowding, many of them underwent changes leading to their transformation into lentoid tissue: the cell nuclei became lighter staining and enlarged, the amount of cytoplasm in each cell increased considerably, and the cells elongated or became pear-shaped. The cells continued to proliferate without, however, retaining the rosette pattern, so that eventually the lumen of the rosette became filled with closely packed, elongated cells. In this form the clusters were histologically identifiable as lenslike bodies or lentoids (Fig. 1*c, d*). In the living cultures such lentoids could be easily spotted by their spheroid shape and their bright translucence. Each lentoid was usually surrounded by a layer of small cells, resembling, in position, early lens epithelium, but, in this case, they were of retinal origin. Since each such culture consisted originally of numerous rosettes, various phases of their transformation into lentoids could be found side by side.

A consistent feature of these lentoid-forming cultures was the presence of numerous loose and rounded retinal cells, most of which showed cytolytic and karyolytic changes. These cells originated in rosettes which, owing to the conditions of the culture, had distintegrated. The appearance of these cytolyzed cells preceded, in time, that of the lentoids, and if the conditions of the culture were such as to prevent the formation or the

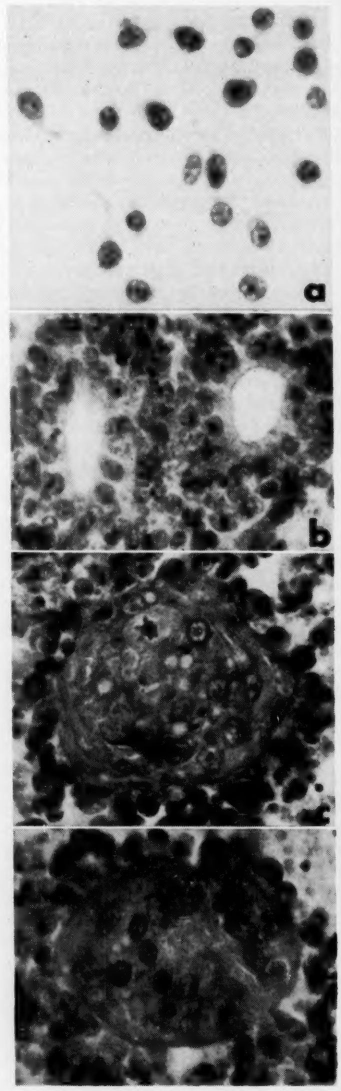

Fig. 1. (*a*) Smear of a cell suspension of neural retina tissue from a 7-day chick embryo (×760); (*b*) rosette-shaped cell aggregates formed in 2-day suspension culture (×620); (*c, d*) lentoids formed in 4-day culture of rosettes on a plasma clot (×620).

accumulation of these cells, no lentoids were formed.

The lentoids could be maintained *in vitro* for from 3 to 4 days, during which time they continued to grow in size, by cell division and through enlargement of the cells. The complete development of their cells into lens fibers was not observed, nor was it expected to take place, since it had been established that the culture environment was unsuitable for the terminal development of lens fibers or for their maintenance in an unaltered state (*7*).

In cultures of undissociated retinal tissue, lentoids were found only in a few isolated instances. They were present only in areas where rosettes had also formed. In all cases the lentoids were accompanied by cytolyzed cells, and their presence could easily be related to injury to the tissue and to its disruption owing to manipulation.

It has been established that the dissociated cells of a variety of embryonic tissues resume, following aggregation, their histotypic structure and course of development in accordance with their origin (*6*). In their ability to assume and pursue, following dissociation and aggregation, an altered course of development, retinal cells provide an interesting exception to the other types of cells studied. The situation in which the transformation into lentoids takes place indicates two sets of preceding and probably prerequisite conditions: the reassociation of the cells in a new pattern (rosettes) and the presence of numerous cytolyzed retinal cells. It should be possible to examine the bearing of each of these conditions on the process of this transformation and, eventually, to decide to what extent it is initiated by stimuli external or intrinsic to the affected cells.

In conclusion, retinal cells of the chick embryo, in being able to become transformed *in vitro* into lentoids, provide an additional example of a tissue which, although apparently "determined" and advanced in its specialization, may, under appropriate circumstances, alter its original course of development (*8*).

A. MOSCONA

Rockefeller Institute for Medical Research, New York, N.Y.

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Thermoperiods and Production of Apothecial Initials in the Fungus Sclerotinia trifoliorum

Sclerotinia trifoliorum Erik. responds to diurnal thermoperiods as indicated in Table 1. When the organism is incubated at constant temperatures, very few apothecial initials, the precursors to the sexual fruiting stage, occur. Other fungi might very well respond in a similar way; they are generally incubated at constant temperatures. The response is similar to that of many other living organisms (*1*). No previous reports, to our knowledge, are available on the influence of thermoperiods on the sexual fruiting stage of a fungus.

Production of the sexual stages of fungi under controlled conditions has been very difficult in many genera and species (*2*). In the past, in the genus *Sclerotinia*, apothecial initials and subsequent apothecia have been produced in culture, but these results could not be repeated with reliability (*3*).

In the experiments described here (*4*), the organism was grown in the dark on ground whole-wheat medium (50 g/lit) in 1.5-percent agar and preincubated at 24°C for 3 weeks in Petri dishes. All plates were sealed immediately with paper masking tape. This is not necessary, but it reduces contamination from repeated handling. Cultures were incubated, after preincubation, at several temperatures for definite time periods by moving the plates manually. Series A cultures (Table 1) were incubated for 8- and 16-hour periods; series B for 4- and 20-hour periods. Both A- and B-series cultures were subjected to temperatures of 7°, 15°, 21°, and 24°C in all possible combinations. Similar culture plates were held continuously at the same temperatures.

From the data, it can be seen that several diurnal thermoperiods influence production of apothecial initials. More than 100 apothecial initials were produced per

Table 1. Effect of cycling thermoperiods on the production of apothecial initials in *Sclerotinia trifoliorum* Erik.

Incubation (°C)					No. of apothecial initials			No. of sclerotia
4 hr	8 hr	16 hr	20 hr	24 hr	13 day	21 day	27 day	
				Series A				
	7	15			0	0	31	202
	7	21			0	72	400	235
	7	24			0	2	34	190
	15	7			0	31	194	234
	15	21			0	7	48	290
	15	24			0	10	67	384
	21	7			0	2	35	179
	21	15			16	242	303	305
	21	24			0	0	0	255
	24	7			0	12	158	259
	24	15			1	48	245	186
	24	21			0	0	0	190
				7	0	0	0	226
				15	0	2	13	209
				21	0	0	34	232
				24	0	0	0	209
				Series B				
7			15		0	0	101	215
7			21		61	188	563	305
7			24		0	15	66	359
15			7		0	0	0	360
15			21		7	81	105	209
15			24		0	0	0	212
21			7		0	0	3	214
21			15		11	56	66	255
21			24		0	0	5	324
24			7		0	0	0	192
24			15		4	64	131	217
24			21		0	23	83	218

plate in the 4- and 20-hour periods when the cultures were held at 7° and 21°C, 24° and 15°, 7° and 15°C, and 15° and 21°C. The largest numbers of apothecial initials were produced in the 8- and 16-hour periods. The plates that were held at constant temperatures continuously produced 13 apothecial initials at 15°C and 34 at 21°C.

It has not as yet been possible to determine the ideal thermoperiod required by the organism because of the numerous possible combinations of temperatures and time periods; 7° and 21°C for 4 and 20 hours seems to be important because some cultures held for 7 months at a continuous 15°C produced apothecial initials in 15 days when subjected to thermoperiods. Apothecial initials have been produced in 40 days in the laboratory. In nature, a period of 7 months is required. Light is essenital for maturity of apothecial initials into apothecia (*5*).

THOMAS SPROSTON, JR.
DANIEL C. PEASE, JR.
*Department of Botany,
University of Vermont, Burlington*

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Dissociation of Human Serum Macroglobulins

The elevated globulins of macroglobulinemic serums (*1*) are usually revealed as a single electrophoretic component with mobilities in the γ- or β-globulin range. However, on examination in the ultracentrifuge, a mixture of molecules showing strongly concentration-dependent sedimentation constants with values of 18, 25, and 32 Svedberg units (S) at infinite dilution is found to make up about 95 percent of the purified material. The appearance of macroglobulins in hyperglobulinemias associated with multiple myeloma is relatively rare. These macroglobulins have sedimentation constants below 15 S and often make up only a minor portion of the total protein (*2, 3*). Evidence has been recently presented that macroglobulins have their antigenic counterparts in normal serum (*3*), and it has been suggested that these molecules might represent discrete aggregates of serum proteins of relatively low molecular weight.

Attempts to dissociate pure macroglobulins electrophoretically by a combination of salt, *p*H, and temperature variations were unsuccessful. However, the addition of sulfhydryl compounds such as mercaptoethanol and cysteine resulted in the conversion of all macroglobulin fractions tested into a molecular entity having a sedimentation constant near that of the usual 6.5-S γ-globulin. One-percent solutions of the proteins studied were treated with 0.1*M* mercaptan in potassium phosphate buffer (ionic strength, 0.2; *p*H, 7.4) over a period of 24 to 48 hours at room temperature. Following this, the sulfhydryl compounds were removed by exhaustive dialysis for 48 to 72 hours against the phosphate buffer or against solutions of the buffer containing 0.02*M* iodoacetate or iodoacetamide. Removal of the sulfhydryl compound by dialysis results in reaggregation, but into molecular components that differ from the original material. The presence of the sulfhydryl blocking agents prevents such reassociation. These compounds have no dissociative effect on the native macroglobulins. Some typical results with an electrophoretically pure macroglobulin are shown in Fig. 1. It can be seen that the macroglobulins of *A* are converted to a single component by treatment with mercaptoethanol. Removal of the sulfhydryl reagent by dialysis leads to a marked diminution of the 6.5-S peak with the appearance of two new components sedimenting near 13 and 18 S (see Fig. 1*C*). If the sulfhydryl reagent is removed in the presence of a sulfhydryl blocking agent, in case of Fig. 1*D*, iodoacetate, the protein persists in the 6.5-S form. Such results indicate that the depolymerizations noted are the result of the breaking of disulfide bonds.

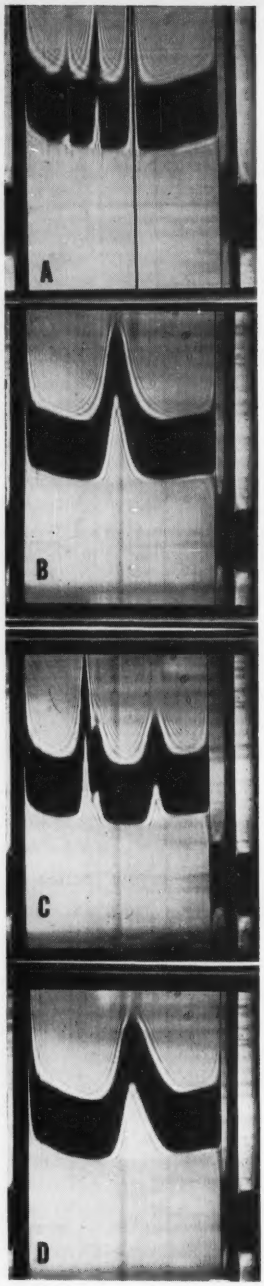

Fig. 1. Spinco ultracentrifuge diagrams (direction of sedimentation is to the left) of a purified macroglobulin fraction and the products derived from it. The times of centrifugation at 59,780 rev/min are given in parentheses. All samples contained potassium phosphate. (*A*) Parent macroglobulin (20 min); (*B*) macroglobulin after 48-hr treatment with 0.1*M* mercaptoethanol (65 min); (*C*) sample *B* after 48-hr dialysis against 0.02*M* sodium acetate (30 min); (*D*) sample *B* after 48-hr dialysis against 0.02*M* sodium iodoacetate (60 min).

A macroglobulinemic multiple myeloma serum protein (LE, *3*) was also converted to the 6.5-S component on treatment with mercaptoethanol, but unlike the 18- to 32-S type of macroglobulin, it did not spontaneously reaggregate on removal of the sulfhydryl agent. About 80 percent of the 18-S component of normal human serum which makes up nearly 2 percent of the total serum protein is converted to a smaller molecular entity by mercaptoethanol. The 9.5-S component of normal γ-globulins which forms on aging of samples is not affected by this type of treatment.

The physical and immunochemical relationships of the monomer units to the parent and reaggregated fractions are being studied. The data promote our earlier hypothesis that macroglobulins may be aggregates of normal serum globulins of molecular weight near 160,000 (*4*).

H. F. DEUTSCH
JANE I. MORTON
*Department of Physiological Chemistry,
University of Wisconsin, Madison*

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Effects of Zinc and Amino Acid on Cell Division in Ustilago

Grimm and Allen (*1*), studying cytochrome synthesis in *Ustilago sphaerogena*, reported that when zinc was added to the liquid growth medium used for this organism, a culture of single ovid cells was produced and cytochrome formation was promoted. Without zinc, the cells were filamentous in form. Apparently zinc was involved somehow in cellular processes related to cell division.

In studies in our laboratory, an opposite effect of zinc was observed. The strain of *Ustilago sphaerogena* (*2*) used in this work produced long clumped cells when zinc was added to the basic medium. Thus, zinc, whether it promotes or hinders division, appears to be involved in reactions intimately related to the processes by which, as a culture of *Ustilago* grows, cells divide to form additional, small, uniform cells.

It was also observed in our studies that differences in cell form occurred in cultures that were grown on different amino acids or ribonucleic acid as nitrogen sources. Apparently these acids influence other cellular reactions involved in cell-division processes, and cell form may vary from short, rod-shaped cells to long, tangled, mycelium-like cells.

In our experiments, cultures were grown at 23° ± 1°C in 125- or 250-ml erlenmeyer flasks on a reciprocal shaker. Medium A (*1*), without zinc or thiamine, was used as the basic medium. Concentrations of hydrogen ion in the several media were similar and remained fairly constant (see also *3*). Cells were examined microscopically, and, in lieu of a completely quantitative method, were assigned percentage-wise to the following classes. Class 1: long, clumped, mycelial-type cells. Class 3: long, single cells (over 70 μ). Class 5: intermediate-sized, single cells (approx 35 to 70 μ). Class 7: short, single, rod-shaped cells approximately 20 μ in length. The sum of the products of class numbers multiplied by the percentage of each class in a culture provided a form index. An index of 250 or less describes a culture consisting mostly of long cells; an index of 550 or more a culture consisting primarily of short cells. Cultures of short cells or long, clumped cells were easy to rate; cultures of a mixed type, because of the estimated percentages, were not as accurately described. Cells of all classes except short rods occurred both in branched and in straight form.

Table 1 lists some of the form indices obtained. The zinc effect occurred when zinc was added to the basic medium or to media in which an amino acid substituted as a nitrogen source for the ammonium acetate of the basic medium. The effect occurred with addition of only a small amount of zinc, and it was similar following tenfold or still greater zinc additions. The long cells appeared in zinc-supplemented cultures only after more than 18 hours of growth (the log phase of growth was reached at 2 to 4 hours and ended at 36 to 40 hours in control cultures). Growth, in terms of dry weight, with added zinc or on an amino acid was quite similar to growth on the basic medium. The dry-weight figure shown for proline (Table 1) is low; in other experiments, in which a complete survey of amino acids was made (*3*), this acid produced a dry weight only slightly less than that produced by the basic medium.

Table 1. Cell form in cultures of *Ustilago sphaerogena* grown on various nitrogen sources and with or without added zinc. The starting cell concentration was 1.4×10^6 cells/ml. An index of 250 or under describes long cells; one of 550 or over describes short cells. The control was cultured in 0.3-percent ammonium acetate.

Nitrogen source	Zinc added (ppm)	Cell index		Dry wt. (percentage of control) at 46 hr
		18 hr	46 hr	
Ammonium acetate (0.3%)	0	680	700	100
Ammonium acetate (0.3%)	0.2	685	205	118
Ammonium acetate (0.3%)	1.0	690	260	99
Ammonium acetate (0.3%)	5.0	680	200	101
Glycine (0.3%)	0		210	93
Glutamic acid (0.3%)	0		420	124
Glutamic acid (0.3%)	1.0		180	105
Proline (0.3%)	0		700	71
Proline (0.3%)	1.0		120	100
Ribonucleic acid (0.3%)	0		130	89

Because growth was not markedly changed, it appears that the cellular reactions involved in these form changes are specifically related to processes of division. Although speculation concerning what reactions are affected does not seem appropriate at this time, these observations add to the list of agents which may be used as tools in studying cell-division processes. Such studies, in addition to their intrinsic value, have particularly pertinent application in the area of cellular injury by ionizing radiation (*4*).

EDWARD SPOERL
ALVIN SARACHEK
NORMA PUCKETT

U.S. Army Medical Research Laboratory, Fort Knox, Kentucky

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Influence of Gibberellins on Stem Elongation and Flowering of Endive

The gibberellins, which are metabolites of the fungus *Gibberella fujikuroi* (Saw.) Wollenweber (*1*), produce rapid stem elongation in numerous plants even when they are applied in quantities as small as 5 μg per plant (*2*). Lang (*3*) induced flower formation in biennial *Hyoscyamus niger* L. by applying a total of 60 μg of gibberellin under conditions of warm temperature and short day. *Hyoscyamus* normally requires a cold period followed by long days for flower induction. Flowering in endive, *Cichorum endiva* L., is hastened by a period of growth under long days, in bright light, or in the cold either as seed vernalization or during early development (*4*).

This report describes the interaction of vernalization and gibberellin on growth and flowering in endive. The gibberellins used were a mixture of gibberellin A and gibberellic acid (*5*) hereinafter referred to as "gibberellins." Seed of variety Fullheart No. 5 from Nunhem, Haelen, Holland, was used. For the vernalized seed, sufficient water was added to raise the moisture content to 40 percent on a dry-weight basis. The

Fig. 1. Apical portions of vernalized and nonvernalized endive as affected by single and repeated applications of gibberellins. (*A*) Not vernalized, 50 μg; (*B*) not vernalized, 450 μg; (*C*) vernalized, no treatment; (*D*) vernalized, 450 μg; (*E*) vernalized, 50 μg. Photographed 27 Sept. 1956.

moist seed was held for 6 hours at 25°C and then placed in a saturated atmosphere at 2.5°C for 4 weeks beginning 29 June 1956. On 27 July, the vernalized and unvernalized seeds were planted in flats in a greenhouse that was kept at a night temperature of 18°C and a day temperature of 22°C or higher.

After 1 Oct., the plants received a 16-hour day, supplementary incandescent light being used to obtain it. Treatments with the mixture of gibberellin A and gibberellic acid were begun on 3 Aug. 1956, when the seedlings emerged. An application of 0.05 ml of an aqueous solution of the mixture of gibberellins (1000 μg/ml) was applied to the stem apex of each seedling. There were six treatments, as is shown in Table 1. The total amount of gibberellins applied to the plants that received only one application, on 3 Aug. was 50 μg; the plants that were treated weekly from 3 Aug. until first anthesis on 4 Oct. received a total of 450 μg.

Ten days after the first application of the gibberellins, stem elongation was visible on all treated plants, irrespective of vernalization. Thirty-one days after treatments began, stem elongation of untreated vernalized plants became evident. By comparison, untreated, unvernalized plants at this date continued to exhibit typical rosette growth with 20 to 30 leaves.

Table 1 shows the marked elongation that occurred in plants treated with gibberellins. Repeated applications resulted in the greatest stem elongation. Especially noteworthy is the increase of stem height exhibited by the unvernalized plants (167.5 cm), as compared with vernalized plants (135.2 cm) following repeated applications of the mixture. This is probably explained by earlier flower induction in the vernalized plants (Table 1).

By 9 Oct., repeated applications of gibberellins to the vernalized plants had induced a greater percentage of incipient inflorescences as well as earlier flowering than vernalization alone (treatments 4 and 6, Table 1). However, development through flowering of the treated plants was distinctly different from that of untreated, vernalized plants. In the plants that were not treated with gibberellins, flower primordia were observed under the binocular microscope almost as soon as elongation was visible. The flowers were sessile and normal in size, color, pollen content, and seed set. On the other hand, the vernalized plants that received repeated applications had stems 75 to 100 cm high before flower primordia could be observed under the binocular microscope. The first flower heads occurred on very long peduncles (Fig. 1); the flowers were small and pale blue and had brownish stamens with very little pollen. The pollen appeared to be viable, for it stained pink with acetocarmine, although no seed developed from them. Following cessation of treatment, blossoms were normal in all respects.

Flowering occurred on vernalized plants of all treatments, but, significantly, weekly applications of gibberellins also induced flowering in nonvernalized plants. In the latter plants, the first flowers produced were similar to the abnormal ones on vernalized plants that received repeated applications of gibberellins (treatment 6). When the mixture of gibberellins was applied once to vernalized plants, elongation occurred to about 30 cm, after which (9 Oct.) vegetative rosettes formed at the stem apices (Fig. 1). Eventually, 78 percent of these plants produced flower parts (Table 1).

The production of normal blossoms following termination of repeated treatments is an indication that gibberellins have limited residual properties. However, the early induction of flowering by a single application to the first leaves of endive (treatment 2) further suggests (6) a possible basic role for gibberellins in the flowering mechanism.

J. F. Harrington
Lawrence Rappaport
K. J. Hood

Department of Vegetable Crops, University of California, Davis

Table 1. Effects of a mixture of gibberellin A and gibberellic acid on stem height and flowering of endive.

Expt. No.	Gibberellin treatment	No. of plants	Avg. stem length (cm)	9 Oct. 1956: Incipient inflorescences (%)	9 Oct. 1956: Open flowers (%)	26 Oct. 1956: Incipient inflorescences (%)	26 Oct. 1956: Open flowers (%)	3 Dec. 1956: Incipient inflorescences (%)	3 Dec. 1956: Open flowers (%)
Unvernalized									
1	Untreated	39	< 1.0	0	0	0	0	22	0
2	50 μg once	36	31.7	0	0	28	0	78	65
3	50 μg/wk	10	167.5	30	0	100	30	100	100
Vernalized									
4	Untreated	27	14.6	59	0	85	7	100	51
5	50 μg once	29	80.2	90	0	90	41	94	89
6	50 μg/wk	34	135.2	100	21	100	86	100	100

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3 January 1957

Preparation of Tritiated 7,12-Dimethylbenz(a)anthracene

The preparation of 7,12-dimethylbenz-(a)anthracene (DMBA) containing tritium was undertaken (*1*) with the purpose of having available a strong carcinogen that might be used in studying its metabolism in mouse skin. The carcinogen was labeled with tritium by a direct-exchange method. The tritiated compound had a specific activity of 1.62×10^5 disintegration/min mg. Labeling of a carcinogenic polycyclic aromatic hydrocarbon with tritium has not been previously reported.

Replacement on the aromatic nucleus of hydrogen atoms with tritium atoms was accomplished by means of direct exchange in the presence of a catalyst. The exact mechanism of the exchange reaction is not known. However, it has been used successfully in labeling benzene, cholesterol, and Δ^4-androstene-3,17-dione with tritium, and cholesterol with deuterium (*2*).

Two samples of tritiated DMBA were prepared, the temperature of the reaction being the only variable. Seven hundred seventy-five milligrams of DMBA was weighed into a heavy-walled Pyrex tube. Seventy-five milligrams of reduced platinum dioxide in a solution of 9.2 ml of glacial acetic acid, 2.0 ml of glass-distilled water, and 2.0 ml of tritiated water (containing 4.0 mc/ml) (*3*) were added to the reaction tube. The tube was evacuated, flame-sealed, and then placed inside a length of iron pipe that was capped at both ends. The reaction mixture for the first sample was shaken at room temperature for 14 days; for the second sample, the mixture was placed in a shaker oven at 100° C for 14 days.

Following the reaction period the liquid was distilled off in a vacuum at 50° C, and the crystalline product was dissolved in redistilled petroleum ether (Skellysolve B) and chromatographed in the dark on Florisil (100 to 200 mesh) with petroletum ether as the eluant. The progress of the chromatography was observed by occasional momentary exposure to ultraviolet light. Two fluorescent bands were observed. The main band was bright blue and was rapidly eluted with petroleum ether and collected. Just beneath the platinum, which remained as a black deposit on the surface of the Florisil column, a narrow, yellow fluorescent band was observed; this band did not change position during development of the column.

The crystalline product was recovered from the petroleum ether eluate by slow evaporation under a nitrogen stream. The crystals were very pale yellow and melted at 123.0° to 123.8°C (recorded mp of nonradioactive DMBA: 122.8°–123.5°C, corrected, *4*). When dissolved in 95 percent ethanol, the material showed an ultraviolet absorption spectrum identical with that of the nonradioactive carcinogen.

The tritium-labeled carcinogen was dissolved in toluene containing 0.3 percent 2,5-diphenyloxazole, and the radioactivity was determined with a liquid scintillation counter (*5*). Corrections of the counts were made for internal quenching by using a standard DMBA solution containing known added radioactivity.

After corrections for internal quenching and for counting efficiency had been made, the specific activity of the sample prepared at room temperature was 2.98×10^3 disintegration/min mg, and that of the sample prepared at 100°C was 1.62×10^5 disintegration/min mg. The application of heat to the reaction mixture produced a 54-fold increase in the radioactivity of the sample.

Although it is recognized that the method described here produced samples of relatively low radioactivity, it is probable that samples with a much greater specific activity might well be obtained by using water containing a high percentage of tritium.

GERALD R. CLEMENTS*
W. T. HILL

Pathology Department, Northwestern University Medical School, Chicago, Illinois

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* Present address: Department of Pharmacology and Chemotherapy, Armour Laboratories, Kankakee, Ill.

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Suppression of Radiation Interference in Flame Photometry by Protective Chelation

Radiation interference is the enhancement or suppression of the light emitted by an excited ion when other species of ions are present in solution. This phenomenon was first observed in the determination of cations in urine by emission spectroscopy (*1*). It was found that the radiation interference was proportional to the amount of interfering ion present until a limiting value was approached. Correction was attempted by the use of synthetic standards containing predicted amounts of interfering substances or by a "method of excess" in which both samples and standards were made up to contain amounts of interfering ions sufficient to cause maximum suppression.

Table 1. Effects of radiation interfering substances on luminosity of calcium at 554 mμ.

Interfering substance (ppm)	Net luminosity of 48-ppm calcium samples determined as $CaCl_2$: Control	In the presence of 5000 ppm EDTA and 6000 ppm KOH
None	54	49
Sulfate (500)	26	49
Nitrate (500)	38	50
Phosphate (500)	13	29
Magnesium (20)	50	51

The development of the flame photometer (*2*) made possible the rapid, accurate analysis of many cations. However, radiation interferences made difficult the determination of calcium and magnesium from biological and geologic sources. The radiation interferences of sodium and potassium may be eliminated by the use of an internal standard of additional calcium (*3*). The method of excess does not yield accurate results in the case of interference by phosphate in biological samples (*4*). Of the anions studied here (*5*), nitrate, sulfate, and phosphate produce an increasing degree of suppression (Table 1).

Ethylenediaminetetraacetic acid (EDTA) may be used to chelate polyvalent metal ions in a solution and thus protect the calcium from the radiation interference of other ions (*6*) (Table 1). The correction of the interference of sulfate, nitrate, and magnesium on calcium is demonstrated within the precision of the method (± 1 unit). The interference of the phosphate is markedly reduced compared with the external standard for the series.

However, by a combination of the protective chelate and internal-standard techniques, accurate determinations may be obtained of up to 25 ppm of calcium ion in the presence of 300 ppm of phosphate solutions containing 5000 ppm of EDTA and 6000 ppm of KOH. The chelate functions to prevent a radical change in the amount of calcium that is free to interact with phosphate within the limits of the calcium-EDTA equilibrium. Solutions of calcium chloride

exhibit a linear increase of luminosity as a function of concentration with up to 50 ppm of calcium ion in the presence of 5000 ppm of EDTA and 6000 ppm of KOH.

The applications of protective chelation with the use of internal standards for the flame-photometric determination of calcium and other cations in biological samples are under investigation.

JONATHAN D. WIRTSCHAFTER*
Research Laboratory, Veterans Administration Hospital, Portland, Oregon

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* Present address: Harvard Medical School, Boston, Mass.

9 January 1957

Evaluation of Chloroform Activation of Human Plasminogen

The presence of spontaneous proteolytic activity in human blood was first recognized 60 years ago (*1*). The observations were extended when it was discovered that chloroform treatment of human serum increased the proteolytic activity (*2*). Recently it was found that the production of proteolytic activity of human plasma or, in later experiments, of fraction III isolated from human plasma by cold ethanol fractionation (*3*) was more effectively achieved by reaction with streptokinase, a metabolic fermentation product of certain streptococci (*4*). It was of even more interest, however, that the reaction mixture of fraction III and streptokinase possessed considerable fibrinolytic activity.

In contrast, treatment of human fraction III with chloroform did not produce measurable fibrinolytic activity. The difference in behavior of the two activators has created considerable confusion; we have made an attempt to explain these divergences.

An aqueous acid extract of human fraction III was adjusted to a *p*H of 7.8, shaken with one-fifth its volume of chloroform, and left in contact at room temperature. At intervals, samples were analyzed for proteolytic activity by measurement of casein hydrolysis according to the method of Kunitz (*5*).

Proteolytic activity developed slowly but measurably over a period of several days. Addition of minute amounts of streptokinase-activated human fraction III (that is, human activator) increased the proteolytic activity during the first days of incubation, whereas after about 10 days of standing in contact with chloroform, no additional proteolytic activity was produced.

Concurrently, the determination of fibrinolytic activity of the reaction mixture was carried on according to our modification (*6*) of the procedure of Christensen (*4*). No measurable activity could be detected. However, addition of streptokinase brought forth rapid lysis of the standard fibrin clot.

These experiments may readily be explained in view of the recently proposed mechanism for the "activation of human plasminogen by streptokinase" (*7*). Only the proteolytic precursor is converted in contact with chloroform to the active proteolytic enzyme. The same conversion can be achieved by catalytic amounts of human activator which is produced by the reaction of streptokinase with human fraction III. This latter path of conversion is catalyzed by human activator to the extent of the presence of proteolytic precursor. After its exhaustive conversion in contact with chloroform, addition of human activator will not increase the proteolytic activity (Fig. 1).

The proteolytic component of human fraction III did not effect this conversion. Human fraction III that had been activated by streptokinase was heated at *p*H 2.0. The mixture contained 50 percent of the original proteolytic activity, but it did not possesss fibrinolytic activity or the ability to catalyze the conversion of the proteolytic precursor to the active proteolytic enzyme.

The proactivator component of human fraction III was not affected by treatment with chloroform and could be converted to the activator by reaction with streptokinase regardless of the length of time of prior incubation with chloroform. The resulting fibrinolytic activity is a direct measure of the activator activity and can be demonstrated only on a fibrin substrate that contains the proteolytic precursor (*8*). The therapeutic efficacy of streptokinase-activated human fraction III depends therefore on its activator content, since the clot-dissolving activity of the proteolytic enzyme is very small.

WERNER BAUMGARTEN, ROSE COLE, MAUREL N. RICHARD, FRANK B. SMITH
Merck Institute for Therapeutic Research, West Point, Pennsylvania

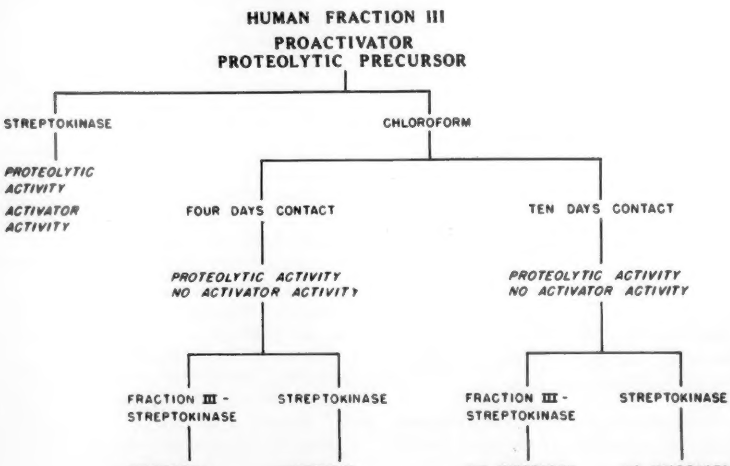

Fig. 1. Activation of human fraction III by chloroform or streptokinase.

References and Notes

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6. Human fibrinogen was substituted for bovine fibrinogen.
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8. Normally, human fibrinogen contains appreciable amounts of proteolytic precursor found in fraction III.

5 November 1956

Book Reviews

Chemical Engineering Practice. vol. 1, *General.* vol. 2, *Solid State.* Herbert W. Cremer, Ed. Academic Press, New York; Butterworths, London, 1956. xiv + 494 pp.; xxii + 632 pp. $17.50 per volume ($13.30 per volume on orders for complete set).

The first two volumes of this comprehensive work (there will be 12 volumes in all), considered on merit alone, give evidence of a major contribution to chemical engineering literature. The editors (Herbert W. Cremer and managing editor Trefor Davies), the publishers, and the contributors of the many authoritative chapters are to be congratulated for undertaking the long-needed task of bringing together all that is chemical engineering. The fine preface by Cremer, the introduction on "The origins of chemical engineering" by D. M. Newitt, and chapter 2, "The chemical engineer," by F. H. Garner, should be required reading for all chemical engineering undergraduates. In approximately 58 pages, the contributors and editors give us an excellent survey of the chemical engineering field. The chemical engineer who reads the preface and chapters mentioned will be proud of his profession and will appreciate that it has come of age.

It is difficult to do justice, short of several pages, to the many topics covered in these first two volumes. They include a heterogeneity of subject matter, but this is peculiar to the field of chemical engineering and in no way reflects on the editing. Nevertheless, there is evidence of design in the arrangement of material.

Volume 1 deals with economics, material and energy balances, pilot and semicommercial units, and design and operation. There are two valuable appendixes, one on preparation of flow diagrams and the other on units and dimensions. In this volume, seven chapters, including the appendixes, are by British engineers and four, by Dutch engineers. None of the contributors is a teacher, but each qualifies as an expert. The number of problems given in the text, with their solutions, as examples is unusual by American standards. There is a minimum of verbosity. Our teachers appear to take delight in setting difficult problems, so involved with data and grammar that more time is used in trying to understand what is wanted than in solving the problem, once it is understood. It should be realized that actual plant problems, while often difficult, are at least understood by those who must solve them. Little is gained by making things more difficult than they are, especially if one considers the rapid pace at which technology is developing and the need for keeping up with current developments. The editors and contributors appear to appreciate these points.

The second volume is in two distinct parts. The first deals with fundamental concepts of the solid state and with metallurgy, including powder metallurgy. The second part is concerned with flow principles in porous masses. A short final chapter on transpiration cooling seems out of place. Again, all but one of the contributors are British and Dutch practicing chemical engineers. The material presented is pertinent, clearly written, and carefully edited. It is significant that in this volume, as in the first, there is no "eruption" of g_c's for conversion of mass to force units, so characteristic of American textbooks. So long as units are self-consistent and stated, there is really no reason for the intense devotion we exhibit toward this symbol.

Altogether, if the remaining ten volumes follow the pattern of the first two in excellence, *Chemical Engineering Practice* will become an indispensable encyclopedia for all practicing chemical engineers and teachers.

J. M. DallaValle
Georgia Institute of Technology

Wire Brush Surgery. In the treatment of certain cosmetic defects and diseases of the skin. James W. Burks, Jr. Thomas, Springfield, Ill., 1956. 154 pp. Illus. $6.75.

The publisher has made this monograph available at an opportune time, when interest in dermabrasive techniques of removing scars and cosmetic defects is keen. This is the first book to be published on the wire-brush method of dermal planing, a special surgical technique of which dermatologists are making increased use.

James Burks covers thoroughly the development of this type of dermabrasion, its indications and contraindications, the selection of patients and sites, psychological considerations, the histology of superficial freezing and of epidermal regeneration, pre- and postoperative management, equipment and refrigerating agents, technique, results and complications, and the handling of special problems.

The text contains sufficient detail on all aspects of wire-brush planing to serve as an excellent primer on the technique and on the fundamentals of the basic sciences underlying the procedure. Chapter II, on anatomical considerations, and chapter III, on histological changes during postoperative healing, are outstanding. The author acknowledges the contribution of Wallace Clark in the preparation of the latter section. Detail in the illustrations of technical procedure, operating-room layout, and equipment, is excellent.

The little volume is concisely written and well documented. Responsible for this, in part, is Lois DeBakey, medical editor, who assisted in its preparation, and to whom the author gives due credit. The monograph is based on the personal experience of Burks in 750 cases and on material used by him in a course of instruction at Tulane University and the Louisiana School of Medicine.

Leon H. Warren
Parke, Davis and Company

Population Genetics: the Nature and Causes of Genetic Variability in Populations. vol. XX of *Cold Spring Harbor Symposia on Quantitative Biology.* Biological Laboratory, Cold Spring Harbor, N.Y., 1955. xvi + 346 pp. Illus. $8.

Readers of the previous 19 volumes of this series do not have to be told of the high standard which the papers of each symposium invariably attain. Readers not familiar with the series will probably include those who are especially interested in the particular subject of the 20th symposium. This subject, population genetics, although perhaps without much appeal to the general public as yet, is one of tremendous importance and one in which enormous advances have recently been made. Geneticists, plant and animal breeders, and anthropologists, alike, can no longer afford to neglect this field.

The present volume is unusual in that it begins with a series of eight papers,

of various degrees of difficulty, on the mathematical and quantitative aspects of population genetics, including an impressive contribution by the young Japanese Motoo Kimura. Following these two sections are others on selection in plants, selection in animals, genetic variability and polymorphism, populations in time and space, and the integration of genotypes. The whole is preceded by a masterly introduction by Dobzhansky and followed by a fine summary by Lerner.

It is hopeless to attempt a full summary of the contents. Instead, let me merely mention two subjects, the importance of which for human evolution has only recently been realized, which are well presented. These are rapid evolution (by E. B. Ford) and polymorphism in man (by A. Allison).

This volume is a must for all those interested in population genetics, human evolution, anthropology, or any one of a number of other disciplines. Like the other volumes, it is well printed on good paper, and there is an index.

William C. Boyd
Boston University School of Medicine

The Future of Arid Lands. Papers and recommendations from the International Arid Lands Meeting. Gilbert F. White, Ed. American Association for the Advancement of Science, Washington, D.C., 1956. 453 pp. Illus. $5.75, members; $6.75, others.

Of the earth's 52 million square miles of land surface, about 35 percent, or more than 18 million square miles, are in the arid or semiarid zone. Just to administer such an area would present problems. Added to the normal problems, others resulting from the climatic, economic, and social instability inherent in the arid regions greatly complicate the government of more than one-third of the earth. Just how complicated the situation is, is discussed in *The Future of Arid Lands*.

This book is a symposium comprising the 31 papers and three statements presented at the International Arid Land Meetings in Socorro, N.M., during April and May, 1955. Scientists from 17 countries participated. The meetings were held under the auspices of the AAAS, with support from UNESCO, the National Science Foundation, and the Rockefeller Foundation.

The papers read at the meetings were prepared in an attempt to answer, or at least to discuss, specific questions: What is the future of the arid lands? Is there any way we can either predict or modify the variability of water supply? Can we utilize the arid lands permanently? Are there sources of water now unused which may be tapped in the future? Can we find or develop plants and animals better adapted to arid conditions?

The tenor of the discussion is well stated by H. O. Sternberg of Brazil: "It is hard enough to develop a system of land use which fully considers ordinary conditions; to contend with unusual circumstances really calls for additional determination, organization, skills and capital." Insofar as answers to the specific questions are concerned, there seemed to be considerable doubt about what might be accomplished.

It is generally agreed that there is little hope of long-range prediction of amounts of precipitation in arid regions, and that there are no distinct drouth cycles. To judge from the reported experience of those working on arid lands in Africa, there is little to be expected from groundwater development. Ground water is too hard to find and, when found, may be too salty.

Throughout the symposium the distinction is made between "oasis" development and land use under local precipitation. Oasis development is dependent on the importation of water from a more humid area. Thus, in an arid region, the extent of development is dependent on the water supply, not on the availability of lands. There appear to be differences of opinion on the objectives of irrigated-land use. C. E. Kellogg, of the United States, thinks that crops grown on irrigated land should be restricted to those which would aid the economy of the surrounding dry-land area. Other authors indicate that the greatest returns from irrigation come from the production of specialty crops which cannot be grown in some seasons in humid areas.

There is much lack of agreement on the best utilization of arid and semiarid land without irrigation. J. Tixeront, of Tunisia, points out that the lack of water and the variability of the climate have numerous economic, social, and political consequences and concludes that nomadism is, therefore, obligatory for complete utilization of very arid areas. His conclusion that the arid regions cannot exist by themselves can be viewed in two ways—a justification for the domination of arid regions by their more fortunately watered neighbors or a realistic evaluation of the need for subsidy to arid regions. (Our own arid West under the present drouth is one example.) If true, this dependence must act as an automatic brake on the drive toward nationalism of some of the Near East nations so much in the news today.

The attitude of the technicians in the many fields represented at the conference is of great interest to me. The meteorologist insists that we cannot solve the arid-land problem without a thorough knowledge of meteorology. Likewise, the soil scientist. The geologist stresses the need for a thorough knowledge of his subject in a search for ground water, and the hydrologist is dismayed at the lack of information relating rainfall and runoff—even more dismayed at the difficulty in collecting adequate data.

No doubt there is much to be said for the modern scientific approach to a solution of land-use problems in the arid regions. But H. L. Shantz, of the United States, reports that olive culture, when practiced as it was in Roman times, is successful today. Frank Dixey, of the United Kingdom, cites instances which indicate that ancient peoples had a precise knowledge of the ground water in North Africa. Pedro Armillas, of Mexico, relates in some detail how archeological studies have shown a high degree of development of arid and semiarid land in pre-Columbian America. E. Evenari and Koller, of Israel, make the following statement: "It is thrilling to see time and time again how the present-day dispositions of highly complex irrigation systems, calculated by trained specialists, with the latest technical aids, coincide with remnants of ancient irrigation systems on the same spot."

The question immediately arises, who were the scientists in those days? If there were none, why were these ancient peoples reasonably successful? Is our real problem the need to know the smallest details of each technique and to collect a measurement of each physical phenomenon? The Roman experience seems to be that, under certain circumstances, the problems of climate can be overcome, to a considerable extent, by reasonable observation of physical conditions and the free application of common sense.

But the other face of the coin was presented by R. O. Whyte, of the Rome staff of the U.N. Food and Agriculture Organization, who argued that much of today's desert area is man-made. This conclusion follows the assumption, also made by others, that there has been no climatic change. Thus, those areas which do not now support agriculture, despite indications of having once done so, are considered to be the results of man's misuse of land.

Almost every participant in the conference warned of the danger of misuse of arid land. This point was emphasized by C. Luker and R. Price of the United States. Nevertheless, there was no agreement about whether there had been major swings in climatic conditions and no agreement on the basic phenomena which control the erosion problem.

Participants in the conference held little hope that there would be new sources of water, either from demineralization of saline waters or from increased precipitation. On the other hand, considerable optimism was expressed concern-

ing our ability to modify plant and animal strains to make them better adapted to desert conditions. Thus, there is, in some fields, room for a great deal of effective work.

The collection of conference papers is a welcome contribution to efforts to educate people in the problems of our use of the arid lands. For those who must deal with the vexing problems of arid-land administration, it can provide no solace beyond that found in the old saying that "misery loves company." Nevertheless, this conference has taken a look at many important considerations, which could be pursued.

For example, should we try to enforce the same social, economic, and political framework in the arid-land regions as has been developed naturally in areas of greater climatic stability? If we do not do so, what pattern should the new framework take? Would the different patterns in arid- and humid-land areas be compatible?

Another line of fruitful inquiry would be, how do we deal with the people involved. This appears to be the crux of the matter. Which has the greatest influence on the erosion problem—a knowledge of whether a drouth has a 5-year or a 10-year recurrence interval or existence of a society that measures its wealth in numbers of cattle, irrespective of quality or salability? What is the minimum standard of living to be expected in desert areas, and what happens when the standard of living of adjacent areas is raised?

All of these were barely touched at the Socorro conference. It would seem that something along these lines might well be the subject of discussion at the next conference.

THOMAS MADDOCK, JR.
U.S. Bureau of Reclamation

Books Reviewed in The Scientific Monthly, April

A Life of Sir William Ramsay, M. W. Travers (Arnold). Reviewed by R. Multhauf.

Science and Civilisation in China, J. Needham (Cambridge Univ. Press). Reviewed by W. C. Boyd.

Biological Treatment of Sewage and Industrial Wastes, J. McCabe and W. W. Eckenfelder, Jr., Eds. (Reinhold). Reviewed by I. E. Wallen.

A Space Traveler's Guide to Mars, I. M. Levitt (Holt). Reviewed by R. Fleischer.

The Old Stone Age, M. C. Burkitt (New York Univ. Press). Reviewed by R. F. Herzfeld.

The World of Mathematics, J. R. Newman (Simon and Schuster). Reviewed by H. W. Syer.

The Earth We Live On, R. Moore (Knopf). Reviewed by J. Kaikow.

On Freedom and Free Enterprise, M. Sennholz, Ed. (Van Nostrand). Reviewed by A. E. Burns.

New Books

Canon Photography. A working manual of 35 mm photography with the Canon V and IVS2. Jacob Deschin. Camera Craft, San Francisco; Fountain Press, London, 1957. 192 pp. $5.95.

Intelligence in the United States. A survey—with conclusions for manpower utilization in education and employment. John B. Miner. Springer, New York, 1957. 180 pp. $4.25.

The Importance of Overweight. Hilde Bruch. Norton, New York, 1957. 438 pp. $5.95.

Integration. Edward J. McShane. Princeton University Press, Princeton, N.J., reprint, 1944. 394 pp. Paper, $2.95.

Quelques Problèmes de Chimie Minérale. Rapports et discussions publiés par les Secrétaires du Conseil sous les auspices du Comité Scientifique de l'Institut. Institut International de Chimie Solvay. R. Stoops, 76–78 Coudenberg, Bruxelles, 1956. 544 pp. Paper, F. 590; Cloth, F. 675.

Logic without Metaphysics. And other essays in the philosophy of science. Ernest Nagel. Free Press, Glencoe, Ill., 1956. 433 pp. $6.

A Natural Science of Society. A. R. Radcliffe-Brown. Free Press, Glencoe, Ill. 1957. 156 pp. $3.50.

The Calculation of Atomic Structures. Based on lectures given under the auspices of the William Pyle Fund of Haverford College, 1955. Douglas R. Hartree. Wiley, New York; Chapman & Hall, London, 1957. 181 pp. $5.

The Criminal, the Judge, and the Public. A psychological analysis. Franz Alexander and Hugo Staub. New chapters by Franz Alexander. Original edition translated by Gregory Zilboorg. Free Press, Glencoe, Ill. rev. ed., 1956. 239 pp. $4.

Advances in Geophysics. vol. 3. H. E. Landsberg, Ed. Academic Press, New York, 1956. 378 pp. $8.80.

Archaeology and Its Problems. Sigfried J. De Laet. Translated by Ruth Daniel. Macmillan, New York, 1957. 136 pp. $4.50.

Bones for the Archaeologist. I. W. Cornwall. Macmillan, New York, 1956. 255 pp. $10.

International Code of Botanical Nomenclature Adopted by the Eighth International Botanical Congress, Paris, July 1954. J. Lanjouw, chairman of editorial committee. International Bureau for Plant Taxonomy and Nomenclature of the International Association for Plant Taxonomy, Utrecht, Netherlands, 1956. 388 pp.

Aerodynamic Components of Aircraft at High Speeds. vol. VII, *High Speed Aerodynamics and Jet Propulsion.* A. F. Donovan and H. R. Lawrence. Princeton University Press, Princeton, N.J., 1957. 845 pp. $17.50.

Introduction to the Geometry of Complex Numbers. Roland Deaux. Translated by Howard Eves. Ungar, New York, 1956. 208 pp. $6.50.

Anleitung Zum Praktischen Gebrauch der Laplace-Transformation. Gustav Doetsch. Oldenbourg, München, Germany, 1956. 198 pp. DM. 22.

Scientific Inference. Harold Jeffreys. Cambridge University Press, New York, ed. 2., 1957. 236 pp. $4.75.

Theory of Lie Groups. I. Claude Chevalley. Princeton University Press, Princeton, N.J., 1946. 213 pp. Paper, $2.75.

Introducing Astronomy. J. B. Sidgwick. Macmillan, New York, 1957. 259 pp. $3.50.

The Physiology of Nerve Cells. John C. Eccles. Johns Hopkins Press, Baltimore, 1957. 270 pp. $5.75.

Demographic Analysis. Selected readings. Joseph J. Spengler and Otis D. Duncan. Free Press, Glencoe, Ill., 1956. 819 pp. $9.50.

The Dentition of the Australopithecinae. Transvaal Museum Memoir No. 9. J. T. Robinson, Transvaal Museum, Pretoria, S.A., 1956. 179 pp.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publisher or agency sponsoring the publication.)

Report of the Explosion at the Metallurgical Laboratory of Sylvania Electric Products, Inc. on 2 July 1956. Submitted to Governor Averell Harriman by the Council on the Use of Nuclear Materials. State of New York, Albany, N.Y., 1957. 50 pp.

A Reconnaissance of the Ceramic and Refractory Clays of Western Australia. Div. of Industrial Chemistry Tech. Paper No. 2. R. W. Cox, A. C. Frostick, W. G. Garrett, W. O. Williamson. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia, 1956. 92 pp.

Genetic Studies with Bacteria. Publ. 612. M. Demerec *et al.* Carnegie Institution of Washington, Washington, 1956. 136 pp. $1.

Contributions on Partially Balanced Incomplete Block Designs with Two Associate Classes. NBS Applied Mathematics Ser. No. 47. Willard H. Clatworthy. National Bureau of Standards, Washington 25, 1956 (order from Supt. of Documents, GPO, Washington 25). 69 pp. $0.45.

Office Noise Studies at Hill Air Force Base. WADC Tech. Note 56-58. ASTIA Document No. AD 110645. Leo L. Beranek *et al.* 1956. 64 pp. *A Compilation of Turbojet Noise Data.* WADC Tech. Rept. 54-401. Norman Doelling, Derwent M. A. Mercer, *et al.* 1957. 126 pp. Wright Air Development Center, Air Research and Development Command, United States Air Force, Wright-Patterson Air Force Base, Ohio (order from ASTIA Document Service, Knott Building, Dayton 2, Ohio).

Central Laboratories for Scientific and Industrial Research, Hyderabad. Annual report. The Laboratory, Hyderabad, India, 1956. 80 pp.

Meetings and Societies

Physics Teachers

The annual winter meeting of the American Association of Physics Teachers was held 30 Jan.–1 Feb., in New York, in conjunction with the meetings of the American Physical Society. Headquarters and site of the meetings was the Hotel New Yorker.

Thirty-six contributed papers were presented during the first three morning sessions. A symposium on "The crisis in secondary-school physics" made up the first afternoon session. Alvin C. Eurich (vice president, Fund for the Advancement of Education), in outlining the "Nature, magnitude, and gravity of the problem," presented statistics which make apparent the interlocking complexities of a situation compounded of an impending great increase in enrollment, a lack of qualified teachers, and a technologic and military situation which produces a shortage of the very people who have the background to be, and to prepare, the teachers.

"How the problem is handled in the U.S.S.R." was discussed by Harry Schwartz (*New York Times*). According to Schwartz, there is also a crisis in education in the U.S.S.R.: where we are running double shifts in the schools, they are running triple ones. There is also a critical shortage of teachers, and the material and economic wounds of a devastating war have by no means been completely healed. The American solution to the problem must and will be one which does not rob the citizen of his individuality and freedom of choice and movement.

J. A. Campbell (program director for summer institutes, National Science Foundation) described the NSF summer institute program for high-school and college teachers and appealed for a larger number of applications from colleges at which physics institutes might be held.

The contribution of Walter C. Michels (Bryn Mawr College) was entitled "Present activities and plans for the future." The Joint Committee on High-School Teaching Materials, established by the American Association of Physics Teachers, the National Science Teachers Association, and the American Institute of Physics, is studying high-school textbooks, the academic background of high-school physics teachers, and the possibility of providing the teacher with material for home study. The committee has also suggested to the College Entrance Examination Board and to the New York State Board of Regents that they modify their examinations so that a course may be given which will emphasize aptitudes that are more than a mere temporary skill in the solving of type problems and in the repeating of definitions. Controversies with departments of education, Michels said, cannot be allowed to dissipate the energy which is essential to a joint effort by scientists and educationists.

Part of the second morning session was devoted to a symposium on "Improving the quality and effectiveness of introductory physics courses—a report on the Carleton conference." Michels spoke on the "Background for the conference." The 27 conference members, representing industry, research, and teaching, met at Carleton College on 5–8 Sept. 1956. Since improvement in the effectiveness and attractiveness of the elementary course would do much to increase the number of physics majors, the conference had, as its prime objective, a study of introductory courses with a view to such improvement. Since any departure from the classical concept of an introductory course must be generally accepted and understood, it was important to have as wide a representation of interest as possible at the conference and to give the results of its deliberations the widest possible publicity.

"Implications for professional education in physics" was the contribution of Frank Verbrugge (University of Minnesota). Fundamental classical physics must continue to be taught to the future physician and engineer, he said, and since the scope of the subject has widened, the time allotted to it must be increased and the mathematical level raised. Thought should be given to utilizing the laboratory time for teaching geometric optics, the theory of electric instruments, elasticity, and those subjects which have a fundamentally experimental basis. He felt that the size of the textbook should be decreased.

Gerald Holton (Harvard University), in discussing the "Implications for nonprofessional education," made the point that the student in general education should have a course which arouses and satisfies his curiosity concerning the physical world and which recognizes the scope and limitations of the physicist's description of his world. The unifying principles of physics must be made understandable and their mathematical formulation must be clarified; their historical background and quantitative nature must be appreciated. Finally, the teacher of the nonprofessional student is challenged to work out and to try new methods of presentation, since many of the old ones are admittedly inadequate.

"Implications for the training of physicists for industry" was the topic of G. C. Higgins (Eastman Kodak Company). The introductory course, in his opinion, should be planned to make it possible for the average student to earn average grades; the work should be practical, and the inventiveness which occasionally accompanies a lack of mathematical aptitude should not be stifled. It is not important to try to make a Ph.D. of every student.

On the last afternoon, in a program of invited papers on topics of current interest, G. L. Pearson (Bell Telephone Laboratories) described and demonstrated the solar battery, and Narinder S. Kapany (University of Rochester), in a paper on "Fiber optics," introduced a new method of "conducting" light through an optical system by means of total reflection in glass and quartz filaments. Harvey White's Pittsburgh experiment on the teaching of high-school physics by television was illustrated by films made during two of the broadcasts.

An annual feature of the winter meeting is the ceremonial session, held jointly with the American Physical Society. E. P. Wigner (Princeton University), as retiring president of APS, delivered the traditional address: his subject was "Relativistic concepts and quantum phenomena." The AAPT's Oersted medal for notable contributions to the teaching of physics was presented to Mark W. Zemansky (City College, New York), who responded with an address on "Fashions in thermodynamics." Emilio Segrè (University of California), in the role of Richtmyer memorial lecturer, spoke on "Antinucleons."

John J. Heilemann
*Ursinus College,
Collegeville, Pennsylvania*

AAAS Southwestern and Rocky Mountain Division Meeting

The annual meeting of the Southwestern and Rocky Mountain Division of the AAAS is to be held at the University of Arizona, Tucson, 28 Apr. through 2 May. The Southwestern Section of the Mathematical Association of America and the

Arizona Academy of Sciences, which will start their annual meetings on 26 and 27 Apr., respectively, have arranged to terminate their sessions in joint meetings with the Southwestern and Rocky Mountain Division.

During the AAAS division meeting the new Biological Sciences Building at the university is to be dedicated. Frank M. Carpenter will deliver the dedicatory address. Another feature will be the annual John Wesley Powell memorial lecture, which is endowed by the Southwestern and Rocky Mountain Division. W. M. Stanley has been selected for this event and will speak on "New concepts of the nature of viruses."

Continuing a series of symposia arranged by the division's Committee on Desert and Arid Zone Research, there will be a session devoted to "Climate and man in the Southwest." Bertha P. Dutton will preside, with the panel of invited speakers consisting of T. L. Smiley, John P. Miller, Emil W. Haury, John Harshbarger, and Paul B. Sears.

Anton Berkman has organized a symposium on "The improvement of science teaching" and will serve as moderator. Panelists are John R. Mayor, John W. Robson, S. H. Lee, and Earl Camp.

The division's presidential address will be delivered by Marlowe G. Anderson on the subject, "Parasitism and evolution." Albert R. Mead is chairman of the committee in charge of arrangements on the Tucson campus.

Military Psychology

The National Academy of Sciences–National Research Council's Division of Anthropology and Psychology has announced that at the request of the U.S. Air Force Air Research and Development Command a 2-day International Symposium on Military Psychology will be held in Brussels, Belgium, at the Palais de Beaux Arts 26–27 July, immediately prior to the opening of the 15th International Congress of Psychology.

The symposium is being organized under the joint direction of the division's Committee on International Relations in Psychology (H. S. Langfeld, chairman) and the Committee on Military Psychology (W. A. Hunt, chairman). The Symposium Program is being planned by an international committee under the chairmanship of Frank A. Geldard of the University of Virginia. Geldard, who is spending this year as Office of Naval Research Scientific Liaison Officer, London, will serve also as general chairman of the symposium.

The program will consist of papers on military psychological research topics by representative psychologists from several Western European countries, the United Kingdom, and the United States. The symposium will be open to the public.

Information with respect to hotels and pensions in Brussels may be obtained in this country from the Sabena Airlines office in any major city.

United Nations-Iran Mapping Seminar

An agreement was signed recently between Hugh L. Keenleyside, director-general of the United Nations Technical Assistance Administration, and Djalal Abdoh, permanent representative of Iran to the United Nations, by which the United Nations and the Government of Iran will sponsor a seminar on topographic mapping as a means of economic development. It is expected that the seminar will be held in Iran next September or October for a period of between 1 and 2 weeks.

The Economic and Social Council in a resolution adopted last year recognized the important role played by reliable cartographic information in economic development and drew the attention of governments to the possibilities offered by technical assistance in this field. The Government of Iran recently set up a National Cartographic Center to carry out a comprehensive mapping program and offered to serve as host country for a mapping seminar. Neighboring countries, such as Afghanistan, Iraq, Pakistan, and Turkey, which have also felt the need for fuller data in connection with development projects, are being invited to attend the seminar, while other countries in the area may be invited to send observers.

The seminar will deal primarily with technical questions related to the production of topographic maps, such as field surveying, aerial photography, and photogrammetry. Technical papers prepared by participants, by international experts, and by the United Nations and its specialized agencies will be distributed, so that participants can study them in advance. It is expected that commercial organizations specializing in the field of cartographic equipment will participate in the exhibition and in demonstrations of their instruments.

The Government of Iran will appoint a high official to act as president of the seminar. An executive director will be designated by the United Nations. A final report containing the full text of lectures and background papers and a summary of technical discussions will be made available to governments requiring it. It is hoped that this seminar will provide participants with knowledge which may be applied directly to specific mapping problems in their own countries and that it will also help their governments in planning and organizing improved cartographic services.

Industrial Research Conference

Industrial executives and the Secretary of the Air Force will be featured speakers at the National Industrial Research Conference in Chicago, 24–25 Apr. Sponsored by Armour Research Foundation of Illinois Institute of Technology, the conference will be the focal point of National Industrial Research Week, 21–27 Apr. More than 500 industrial executives are expected to attend the meeting in the Conrad Hilton Hotel, according to Christopher E. Barthel, Jr., conference chairman and assistant director of the foundation.

The conference will have "Research for profit" as its theme and will deal with management-level decisions on research and development. Three general sessions will be devoted to "Sales growth through research," "More research for the dollar," and "Extra dividends from research."

Spectroscopy at Ohio State

The annual Symposium on Molecular Structure and Spectroscopy at Ohio State University will be held 10–14 June. The order of the symposium has been reversed this year in order to bring the dates of the electronic band spectroscopy sessions nearer to the dates of the Carbon Conference to be held at the University of Buffalo. The mornings throughout the week will be devoted to invited papers and the afternoons to contributed papers. Participants must submit abstracts in duplicate *not later than 19 Apr.* to Harald H. Nielsen, Department of Physics and Astronomy, Ohio State University, Columbus 10, Ohio.

Forthcoming Events

April

29–30. National Assoc. of Boards of Pharmacy, annual, New York, N.Y. (P. H. Costello, NABP, 77 W. Washington St., Chicago 2, Ill.)

29–1. American Assoc. of Spectrographers, 8th annual, Chicago, Ill. (T. H. Zink, H. Cohn & Sons, 4528 W. Division St., Chicago 51.)

29–1. American Geophysical Union, 38th annual, Washington, D.C. (W. E. Smith, AGU, 1515 Massachusetts Ave., NW, Washington 5.)

29–1. American Oil Chemists' Soc., 48th annual, New Orleans, La. (R. T. O'Connor, Southern Regional Research Laboratory, New Orleans.)

29–2. Flight Test Instrumentation Symp., 3rd annual, Los Angeles, Calif. (E. Spencer, Los Angeles Section, Instrument Soc. of America, 5225 Wilshire Blvd., Los Angeles 36.)

29–2. International Acad. of Proctology, 9th annual, New York, N.Y. (A. J. Cantor, IAP, 147–41 Sanford Ave., Flushing 55, L.I.)

29–4. Irrigation and Drainage, 3rd internatl. cong., San Francisco, Calif. (W. E. Blomgren, 260 Leetsdale Dr., Denver 22, Colo.)

30–1. Metal Powder Assoc., 13th annual, Chicago, Ill. (MPA, 130 W. 42 St., New York 36.)

May

1–2. Image Formation and Measurement with Electronic Techniques, symp., Boston, Mass. (F. Brech, 26 Farwell St., Newtonville, Mass.)

1–3. Electronic Components Conf., Chicago, Ill. (R. M. Soria, 1830 S. 54 Ave., Chicago 50.)

1–3. Society for Experimental Stress Analysis, spring, Boston, Mass. (W. M. Murray, SESA, P.O. Box 168, Cambridge 39, Mass.)

2–3. Basic Problems of Biological Aging, internatl. conf. of AIBS, Gatlinberg, Tenn. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6.)

2–4. American Philosophical Assoc., annual, Chicago, Ill. (W. H. Hay, Bascom Hall, Univ. of Wisconsin, Madison 6.)

2–4. Animal Disease and Human Health Conf., New York, N.Y. (Mrs. E. T. Miner, New York Acad. of Sciences, 2 E. 63 St., New York 21.)

2–4. Illinois State Acad. of Science, annual, Normal. (R. A. Evers, Illinois Natural History Survey, Urbana.)

2–4. Kansas Acad. of Science, annual, Manhattan. (C. T. Rogerson, Dept. of Botany, Kansas State College, Manhattan.)

2–4. Midwestern Psychological Assoc., annual, Chicago, Ill. (D. W. Fiske, Dept. of Psychol., Univ. of Chicago, Chicago.)

2–5. Society for American Archaeology, annual, Madison, Wis. (D. A. Baerreis, Dept. of Sociology and Anthropology, Univ. of Wisconsin, Madison 6.)

3. Engineers and Architects Conf., 4th annual, Columbus, Ohio. (G. B. Carson, College of Engineering, Ohio State Univ., Columbus 10.)

3–4. Minnesota Acad. of Science, Rochester. (B. O. Krogstad, Univ. of Minnesota, Duluth 5B.)

3–4. North Carolina Acad. of Science, annual, Winston-Salem. (J. A. Yarbrough, Meredith College, Raleigh, N.C.)

3–4. North Dakota Acad. of Science, annual, Grand Forks. (B. G. Gustafson, Chemistry Dept., Univ. of North Dakota, Grand Forks.)

3–9. Food Additives, 3rd symposium, Como, Italy. (International Bureau of Analytical Chemistry of Human and Animal Food, 18, avenue de Villars, Paris 73, France.)

4–5. American Psychosomatic Soc., 14th annual, Atlantic City, N.J. (I. A. Mirsky, APS, 551 Madison Ave., New York 22.)

4–5. Population Assoc. of America, annual, Philadelphia, Pa. (D. O. Price, Inst. for Research in Social Science, Univ. of North Carolina, Chapel Hill.)

4–7. American Assoc. for Thoracic Surgery, Chicago, Ill. (H. T. Langston, 600 S. Kingshighway, St. Louis 10, Mo.)

5–7. American Soc. for Clinical Investigation, Atlantic City, N.J. (W. H. Wheat, Jr., Steven K. Herlitz, Inc., 280 Madison Ave., New York 16.)

5–9. American Ceramic Soc., 59th annual, Dallas, Tex. (C. S. Pearce, ACS, 4055 N. High St., Columbus 14, Ohio.)

5–10. International Cong. of Otolaryngology, 6th, Washington, D.C. (P. H. Holinger, 700 N. Michigan Ave., Chicago 11, Ill.)

6–9. American Urological Assoc., Pittsburgh, Pa. (W. P. Didusch, 1120 N. Charles St., Baltimore 1, Md.)

7. International Hydrographic Conf., 7th, Monte Carlo, Monaco. (International Hydrographic Bureau, Quai des Etats-Unis, Monte Carlo.)

7–24. World Health Assembly, 10th, Geneva, Switzerland. (World Health Organization, Palais des Nations, Geneva.)

8–9. European Federation of Chemical Engineering, 12th, Amsterdam, Netherlands. (Federation, Frankfurt/Main, 7, Germany.)

8–11. American Astronomical Soc., Cambridge, Mass. (J. A. Hynek, Smithsonian Astrophysical Observatory, 60 Garden St., Cambridge 38.)

8–11. American Helicopter Soc., 13th annual, Washington, D.C. (H. M. Lounsbury, AHS, 2 E. 64 St., New York 21.)

9. Dietary Essential Fatty Acids, Assoc. of Vitamin Chemists, Chicago, Ill. (M. Freed, Dawe's Laboratories, Inc., 4800 S. Richmond St., Chicago 32.)

9–10. Microwave Ferrites and Related Devices and Their Applications, New York, N.Y. (S. Weisbaum, Bell Telephone Laboratories, Murray Hill, N.J.)

9–10. Operations Research Soc. of America, 5th annual, Philadelphia, Pa. (M. L. Ernst, P.O. Box 2176, Potomac Sta., Alexandria, Va.)

9–11. Drugs in Psychotherapy, internatl. symp., Milan, Italy. (Secretary, Pharmacology Inst., Via Andrea del Sarto 21, Milan.)

9–11. Virginia Acad. of Science, Old Point Comfort. (F. F. Smith, Box 1420, Richmond, Va.)

9–12. American Psychoanalytic Assoc., Chicago, Ill. (J. N. McVeigh, APA, 36 W. 44 St., New York 36.)

10–11. Indiana Acad. of Science, Turkey Run State Park, Ind. (H. Crull, Dept. of Mathematics, Butler Univ., Indianapolis 7.)

10–11. Vocational Training and Rehabilitation of the Mentally and Physically Handicapped, Woods Schools Conf., Chicago, Ill. (J. M. MacDonald, Woods Schools, Langhorne, Pa.)

12–13. International Soc. of Broncho-esophagology, cong., Philadelphia, Pa. (C. L. Jackson, 1901 Walnut St., Philadelphia 3.)

12–16. Electrochemical Soc., Washington, D.C. (H. B. Linford, 216 W. 102 St., New York 25.)

12–16. Institute of Food Technologists, annual, Pittsburgh, Pa. (C. S. Lawrence, IFT, 176 W. Adams St., Chicago 3, Ill.)

13–15. Industrial Waste Conf., 12th Lafayette, Ind. (D. E. Bloodgood, Purdue Univ., Lafayette.)

13–15. Radiation Research Soc., annual, Rochester, N.Y. (A. Adelmann, Nuclear Science and Engineering Corp., P.O. Box 10901, Pittsburgh 36, Pa.)

13–15. Recent Developments in Research Methods and Instrumentation, symp., Bethesda, Md. (J. A. Shannon, National Institutes of Health, Bethesda.)

(See issue of 15 March for comprehensive list)

LETTERS

The editors take no responsibility for the content of the letters published in this section. Anonymous letters will not be considered. Letters intended for publication should be typewritten double-spaced and submitted in duplicate. A letter writer should indicate clearly whether or not his letter is submitted for publication. For additional information, see* Science *124, 249 (1956) and 125, 16 (4 Jan. 1957).

Hungarian National Museum

A letter just received, from Zoltán Kaszáb, director of the zoological department of the Hungarian National Museum, details damage to the museum in October and November 1956 [*Science* 125, 342 (22 Feb. 1957)].

The building of the National Museum in Museum Circle burned 24 Oct., with complete destruction of the mineralogical and paleontological collections and library and the zoological exhibits, including the African dioramas. On 5 Nov. the zoological department building, on Baross-strasse, was partly destroyed, with complete loss of collections and libraries of reptiles, amphibians, fish, birds, lower invertebrates, and mollusks. In the insects the Orthopteroidea, Neuropteroidae, and Diptera collections and library were lost. The collections not destroyed were damaged in firefighting. The collection of G. Horvath was thoroughly soaked and about 30-percent destroyed or damaged. The Coleoptera collection survived, but several hundred boxes were soaked, and unworked Hungarian material suffered.

There were no casualties among the zoological staff, and the members have been engaged in transferring and safeguarding the surviving collections and libraries, which have been moved to another building.

Kaszáb asks for help in rebuilding the destroyed collections and libraries.

FLOYD G. WERNER
Department of Entomology,
University of Arizona, Tucson

Medicine and Society

Do sufficient numbers of the medical profession feel an adequate measure of social responsibility? A. Szent-Györgyi's deeply penetrating article on "Science, ethics, and politics" [*Science* **125**, 225 (8 Feb. 1957)] has stirred such questions in my mind and disturbed my thoughts.

The values and benefits of medical science are easily taken for granted. If, however, as medical men we take our social role too much for granted, we may all the more easily be utilized by those whose designs reach further. It is certainly risky to have blind spots in our view; but it could be fatal to be blind to the possibility of such blind spots.

We know that human beings can hardly be understood apart from their environment; as a physician in general practice, at any rate, I believe this to be so. But the mere recognition of socio-economic origins for much of the conflict which disturbs patients is far from a responsible attempt at preventive medicine.

We frighten people about cancer and heart disease. Is it comparable morality to make no protest when dangerous automobile designing, inhuman economic pressures, and morbidly competitive social standards all bring grief to our patients? Insurance companies have enough money at stake in these matters today; surely there is adequate medical and social understanding to justify a cautious but realistic approach and study. Instead of hopeful, fundamental methods we are employing stop-gap solutions and introducing them with a fanfare—for example, tranquilizers, larger mental hospitals, more facilities for more geriatric patients.

The "ethics" of politics and government can be so variable as to be indistinguishable from the dictates of expediency; they are comparable to the assidu-

ous treatment of a disease by symptomatic measures alone. In an unenlightened age this was the best that good men could do. Medical ethics today, however, demand serious consideration of all the underlying pathological processes at work, and the best possible treatment directed thereto.

It is my expectation that, if we do not learn to look around us and see what we do in the context of the whole, then we, as physicians or as any other self-defined group, will be taken at our own valuation and used by others as technicians.

I would be interested to know what others think.

Bruce H. Buchanan
4690 Dundas Street West,
Islington, Toronto, Canada

Research in Science Teaching

A recent editorial, "The fetish of experiment" [*Science* 125, 177 (1 Feb. 1957)] appears to call for the return of science to the Middle Ages. To state, "There are other educational changes that lend themselves to experimental study, but many of the current efforts to improve the teaching of science and mathematics do not," is admitting a dogma and an unscientific attitude as well as an unwillingness to bring in highly qualified research people in the teaching of science. I agree that many of the problems of teaching do not lend themselves to experimental procedures as employed by the physical scientist. However, there are many excellent instruments and methods of evaluation that could determine how effective a given program or approach to teaching science and mathematics can be. Sound techniques in evaluation are adequate for many kinds of teaching problems and may be as effective as experimental procedures which frequently do lend themselves to "fetish of experiment."

Very few scientific organizations and scientists are aware of the existence of the National Association for Research in Science Teaching, which publishes detailed abstracts of doctoral studies in the teaching of science in its official journal, *Science Education*. Not many scientists who are much concerned with the improvement of teaching science have taken the time to examine related studies that have appeared in this journal. The National Science Foundation supports science teachers in summer institutes when they continue their studies in the sciences. No provisions are made at the same time for these teachers of science to be brought up to date in the research work pertaining to the improvement of science instruction. An effective science teacher should be kept up to date, both in the current research in science and in the research of the teaching of science.

Nathan S. Washton
Queens College, Flushing, New York

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ NITROGEN CRYOSTATS permit cooling of infrared detectors to approximately −196°C. Model 147 cryostat consists of a miniature cooling head and a compressor-regulator assembly. The Joule-Thompson effect and regenerative cooling are used. Compressed nitrogen is passed through a miniature heat exchanger where it is cooled by nitrogen returning from an expansion nozzle. The cryostat is available with a variety of cooling heads. Heat-pumping capacities range from 1.5 to 5 watts. (Perkin-Elmer Corp., Dept. S228).

■ DISPOSABLE TRAYS of white or clear plastic are intended to eliminate the washing of test tubes, the need for rubber stoppers, and the problem of disposing of contaminated equipment. Each of 96 cups in the tray holds 2 ml. (Linbro Chemical Co., Inc., Dept. S239).

■ DISPLACEMENT FOLLOWER requires no contact with the object that is to be followed. An intense spot of light from a cathode-ray tube is focused onto the edge of the moving object. Reflected light from the illuminated spot is picked up by a photocell, and used to keep the cathode-ray beam positioned on the edge of the object. Thus the spot of light on the cathode-ray-tube screen traces the motion of the object. A number of models of the instrument are available, with full-scale ranges from 0.1 in. to 4 in., resolutions of 1 part per thousand, and signal output of 40 v full scale. Band width is 0 to 5000 cy/sec. Output impedance is approximately 1000 ohms. Working distances range from ½ to 9 in. (Optron Corp., Dept. S240).

■ NUCLEAR-POWERED BATTERY converts beta emission to light and the light to electricity. The light source consists of a mixture of finely divided phosphor and an oxide of promethium-147. Beta particles excite the phosphor to emit red and infrared radiation. Silicon photocells convert the light into electric current. The prototype battery uses about 4.5 c of the isotope of half-life 2.6 years. Nominal power output of a new unit is 20 μw. The battery, which is shielded to eliminate bremsstrahlung, measures 0.2 in. thick and 0.6 in. in diameter. (Walter Kidde Nuclear Laboratories, Inc., Dept. S221).

■ BIOLOGICAL STAINS AND INDICATORS are listed with prices in 66-page catalog. Accompanying the catalog is a reprint entitled, "Some aspects of biological staining." (Allied Chemical and Dye Corp., Dept. S236).

■ MAGNETIC STIRRER is combined with a hot plate to extend the advantages of magnetic stirring to heating liquids. Hot plate and stirrer can operate independently or simultaneously. Heater power is 700 watts. Temperature is regulated by a bimetallic thermostat. (Fisher Scientific Co., Dept. S244).

■ THERMISTOR RADIOMETER consists of a temperature-detecting head, an amplifier, and a reference back-body for ambient-temperature compensation. The head aperture is approximately ⅝ in. in diameter and has a 20° field of view. Measurement of surface-temperature differences as small as 0.1°C is said to be possible. Metering circuits provide full-scale readings of 10°, 30°, and 100°C above or below ambient temperature. (Williamson Development Co., Inc., Dept. S247).

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Biologist, Ph.D., 35; broad training and interests. Specialty, invertebrates and microbiology; 6 years' teaching invertebrate and vertebrate zoology. Available September 1957. Box 111, SCIENCE. X

Botanist, Ph.D., male, 38; 8 years' experience. Desires teaching, research post. Physiology background, publications. Administrative experience. Box 114, SCIENCE. X

Chemist (major, general chemistry; minor, biochemistry) 6 years, associate professor, biochemistry, one of leading universities; 8 years, director of research, pharmaceutical company. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

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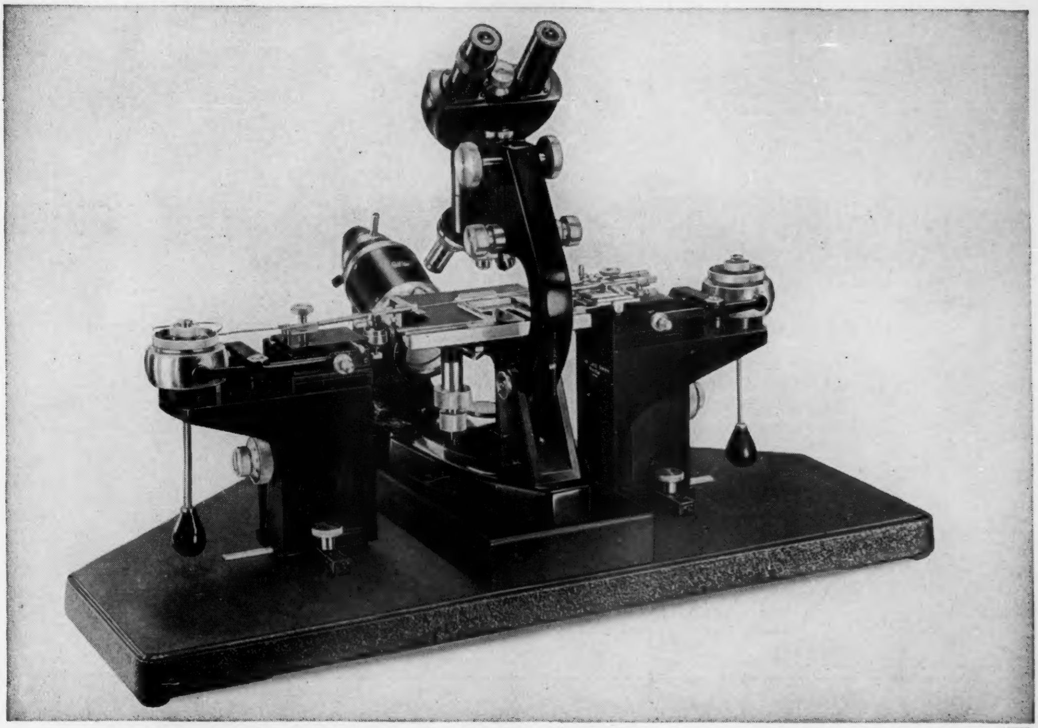

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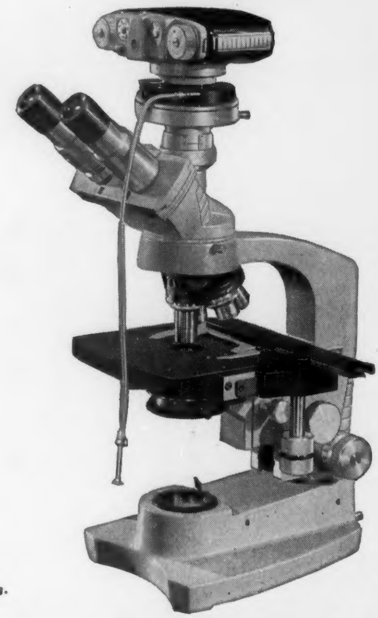

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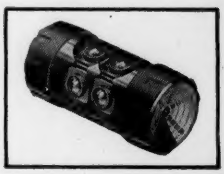

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